The Sensitivity of Bank Net Interest Margins to
Credit, Interest Rate, and Term Structure Shocks

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September 3, 2004

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Abstract

This paper presents a dynamic model that explains variations in net interest margins (NIM) for banks specializing in various types of commercial lending over the business cycle as they respond to credit, interest rate and term structure shocks. Using a large data set consisting of quarterly Call Report and financial market data from 1986 to 2003, we show that various commercial loan specialists are sensitive in varying degrees to credit, interest rate and term structure shocks. Our results suggest that small- to medium-sized commercial lenders were, in general, not able to fully hedge against interest rate volatility or effectively price credit risk over the sample period. In addition, variations in NIM responded to term structure shocks with two- to four-quarter lags. The composition of assets and liabilities, in terms of their repricing frequencies, help amplify or moderate the effects of changes and volatility of short-term interest rates on bank net interest margins depending on the direction of the repricing mismatch.

We also examine the NIM behavior across various time periods that represent different legislative, regulatory and economic environments. We found that despite deregulation, most banks continue to be sensitive to credit, interest rate and term structure shocks. However, the sensitivity of NIM to term structure shocks among commercial lenders seems to have increased over time while the sensitivity to interest rate volatility varied widely across sub-sample periods, possibly reflecting interest rate regime shifts, the degree of hedging activities and/or increased market competition. Finally, our results suggest that commercial lenders may have become more effective at pricing credit risk in the recent period than they were in earlier periods.

1. Introduction

This paper examines commercial banks' ability to respond to credit, interest rate and term structure shocks over the business cycle to minimize volatility in their net interest margins (NIM). Although in practice, bank managers strive to minimize volatility in their after-tax earnings, we narrow our focus to NIM for several reasons. First, despite the rising importance of fee-based income as a proportion of total income for many banks, NIM remains one of the principal elements of bank net cash flows and after-tax earnings.[1] As shown in Chart 1, non-interest income remains a relatively small and usually more stable component of bank earnings and variations in the net interest income, together with provision for loan losses, remain a key determinant of changes in profitability for a majority of banks. Second, given the balance sheet composition of most banks, variations in bank NIM should be tied closely to changes in market interest rates and the term structure. Recent research by Jorion and Mishkin (1991), Estrella and Mishkin(1997), Kozicki (1997) and Schich(1999) confirms early studies that the slope of the yield curve helps to predict real activity and the onset of recessions. In addition, Lown et al. (2000) show that the change in commercial credit standards helps forecast loan growth and real output, which would affect NIM. By examining variations in NIM in response to credit, interest rate and term structure shocks, we can help highlight this complex relationship between interest rate, real activity, underwriting standards and bank performance. Finally, research in the behavior of NIM has been largely limited since the late 1980s when the savings and loan crisis brought the issue of interest rate risk to the forefront. The banking industry has undergone considerable structural changes since then as the legislative and regulatory landscape governing the industry has evolved. These changes, in turn, have had significant effects on the degree of market competition and the scope of products and

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[1] Throughout this paper, net interest margins are defined as annualized quarterly net interest income (interest income less interest expense) as a ratio of average earning assets.

services provided by banks as well as the sources of their earnings. As a result, commercial banks' ability to respond to credit, interest rate and term structure shocks would likely have changed throughout these regime shifts.

We employ a large set of data, consisting of quarterly bank and financial market data from first quarter 1986 to second quarter 2003, to evaluate the behavior of bank NIM over the business and credit cycles. The sample primarily contains small- to medium-sized banks whose main business is to extend credit to commercial entities in the form of commercial and industrial (C&I) loans and commercial real estate (CRE) loans. These groups of banks are of particular interest to us because commercial lending activities have historically shown the greater volatility over the business cycle than any other types of lending activities.

We also investigate whether the sensitivity to shocks varies across different regulatory regimes. We focus on the effects of three key legislative changes on bank NIM during the sample period. These legislative changes have likely altered the sensitivity of bank NIM to credit, interest rate and term structure shocks as they spurred price competition for deposits that reduced volatility in bank lending, improved the capital position of the banks, allowed geographic and earnings diversification and changed the general competitive landscape. Legislative changes we focus on include the Depository Institutions Deregulation and Monetary Control Act (DIDMCA) of 1980 that set in motion the phasing out of the Regulation Q ceilings on deposits, the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 and the Riegle-Neal Interstate Banking and Branching Efficiency Act (Riegle-Neal) of 1994 that became effective in July 1997.[2] No empirical study to date has investigated the effects of these legislative changes on the behavior of bank NIM.

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[2] See FDIC (1998) for detailed discussion on the legislative and regulatory history of the banking history in the 1980s and early 1990s.

Our empirical results show that net interest margins associated with some specialized bank portfolios are considerably more sensitive to interest rate changes than others. The magnitude of these effects depends on the repricing composition of existing assets and liabilities, with banks that have a higher proportion of net short-term assets in their portfolio experiencing a greater boost in their NIM as interest rates rise. We find that changes in bank net interest margins are typically negatively related to interest rate volatility but positively related to increases in the slope of the yield curve that has been shown to consistently precede growth in real activity. Changes in the yield spread have significant and lingering effects on NIM. We find that bank NIM is negatively related to an increase in realized and expected credit losses. We posit that this inverse relationship between realized credit risk, as indicated by an increase in nonperforming loans, and net interest margins exists because bank examiners encourage banks to reduce their exposure to risky credits as loan quality is observed to be deteriorating. Finally, we generally find that the estimated parameters of the models differ by sub-period for banks with different product line specialties in ways that are statistically and economically meaningful.

This paper extends existing literature in NIM in three important ways. First, we develop a dynamic model of variations in NIM in response to market shocks that more closely resembles the actual decision making process of bank managers than existing models. Second, by treating the banking industry as inherently heterogeneous by dividing banks into groups based on their product line specializations, we are able to proxy broad differences within the banking industry, and identify groups of banks that are most sensitive to credit, interest rate and/or term structure shocks. Finally, we are able to measure the effect of regulatory regime shifts in differences across sub-periods for the same group of banks.

The rest of the paper is organized as follows. Section 2 contains a review of the literature relating to interest rate effects on bank net interest margins. In section 3, we present a theoretical

model of bank behavior in response to interest rate shocks.   Section 4 discusses empirical

specifications for the model, data and results of the empirical model. Finally, section 5 concludes

the paper.

2. Literature Review

Since the late 1980s, there has been little published research on the effects of interest rate

risk on bank performance.[3] Theoretical models of net interest margins, mostly developed in the

1980s, have typically assumed that the net interest margin is an objective to be maximized. In the

dealer model developed by Ho and Saunders (1981), bank uncertainty results from an asynchronous

and random arrival of loans and deposits. They find that after controlling for idiosyncratic factors,

the "pure interest margin" depends on the degree of management risk aversion, the size of bank

transactions, the banking market structure, and interest rate volatility, with the rate volatility

dominating the change in the pure interest margin over time. Allen (1988) extends the single

product model of Ho and Saunders to include heterogeneous loans and deposits and posits that pure

interest spreads may be reduced as a result of product diversification. Saunders and Schumacher

(2000) apply the dealer model to six European countries and the U.S. using data for 614 banks for

the period from 1988 to 1995 and find that regulatory requirements and interest rate volatility have

significant effects on bank interest rate margins across these countries. Angbazo (1997) develops

an empirical model, using Call Report data for different size classes of banks for the period between

1989 and 1993, incorporating credit risk into the basic NIM model and finds that the net interest

margins of commercial banks reflect both default and interest-rate risk premia and banks of

different sizes are sensitive to different types of risk.

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[3] Despite significant regulatory concern paid to the interest rate risk that banks face (OCC, 2004 and BIS, 2004), research on a key component of earnings that may be most sensitive to interest shocks, namely bank net interest margins, has been limited thus far, particularly for U.S. banks.

Zarruk (1989) presents an alternative theoretical model of net interest margins for a banking firm that maximizes an expected utility of profits that relies on the "cost of goods sold" approach. Zarruk posits that under a reasonable assumption of decreasing absolute risk aversion, the bank's spread increases with the amount of equity capital and decreases with deposit variability. Zarruk and Madura (1992) show that when uncertainty arises from loan losses, deposit insurance and capital regulations, higher uncertainty of loan losses will have a negative effect on net interest margins. Madura and Zarruk (1995) find that bank interest rate risk varies among countries, which supports the need to capture interest rate risk differentials in the risk-based capital requirements. However, Wong (1997) introduces multiple sources of uncertainty to the model and finds that size-preserving increases in the bank's market power, an increase in the marginal administrative cost of loans and mean-preserving increases in credit risk and interest rate risk have positive effects on the bank spread.

Both the dealer and cost-of-goods models of net interest margins have two important limitations. First, these models are single-horizon, static models in which homogenous assets and liabilities are priced at prevailing loan and deposit rates based on the same reference rate. In reality, bank portfolios are characterized by heterogeneous assets and liabilities that have different security, maturity and repricing structures that often extend far beyond a single horizon. Banks' ability to respond to shocks in the period *t* is constrained by the *ex ante* composition of their assets and liabilities and their capacity to price changes in risks effectively. In addition, the credit and business cycles and the strength of new loan demand determine the magnitude of interest rate shocks on banks' earnings.[4] To the extent that recessions and expansions can be forecast with

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[4] In this regard, Hasan and Sarkar (2002) show that banks with a larger lending slack, or a greater amount of "loans-in-process," are less vulnerable to interest rate risk than those with a smaller amount of "loans-in-process." Empirical evidence, using aggregate bank loan and time deposit (CD) data from 1985 to 1996, indicates that low-slack banks indeed have significantly more interest rate risk than high-slack banks. The model also makes predictions regarding the effect of deposit and lending rate parameters on bank credit availability that were not empirically tested with aggregate data.

lagged changes in the slope of the yield curve, changes in the spread of long-term and short-term

interest rates will forecast loan demand and growth as well as changes in interest rate risk for

banks.[5] Second, these models treat the banking industry either as homogenous or having limited

heterogeneous traits based only on their asset size. However, banks with distinct product line

specializations usually differ in terms of their pricing power and funding structure, all of which

likely affect net interest margin sensitivity to interest rate and other shocks.

3. A Model of Bank NIM

3.1 Interest Rate Changes

The model of bank behavior relating to net interest margins used in this paper assumes that

at each period a bank can significantly but not completely choose the amount of investment in

assets and liabilities of different repricing frequencies, given past choices that are immutable.

Admittedly, this is a fuzzy statement as to the choices available to a bank, but banks have a

moderate degree of control over their asset mix in the short-run (from quarter to quarter) by

purchasing or selling assets of different repricing frequencies. As suggested above, bank's choice of

principal product line specialization will determine the market conditions they face that may limit

their ability to make rapid asset portfolio adjustments. The same is true for bank liabilities.

Bankers can pay them early, deposits can be received and withdrawn at random, and some, like

Federal Funds and repurchase agreements, are under the control of the bank and can be changed

overnight.

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[5] The various studies by Mishkin, Estrella and others clearly show that there is a very direct and strong relationship
between lagged changes in the term structure slope and the likelihood of recession or expansion. We have updated these
estimates (not reported) to include the 2001 recession. Our findings are consistent with those of Mishkin and Estrella
with pseudo-R^2 of 0.43 using quarterly data for the period 1960 to 2003 and a term structure slope of the difference
between the constant maturity yields on the 5-year Treasury Note and 1-year Treasury Bill. The results are robust for
different sub-periods as well.

In contrast to banks' ability to make portfolio adjustments, banks have little control over market interest rate changes and interest rate volatility. When contracts on assets or liabilities are negotiated, banks may, through market power, be able to set levels or mark-ups (mark-downs) over index rates such as LIBOR, but are unable to control index rate changes. In addition we assume that mark-ups are contractually fixed in the short-run. Furthermore, they are unable to change their chosen product line specialization in the short-run so that such changes are strategic options only.

In our modeling of bank responses to credit and interest rate risks, we assume that banks are most interested in achieving the best after-tax profit performance they can in order to provide shareholders with maximum value. Maximizing shareholder value in a dynamic context, however, is a daunting problem and requires considerable judgment. Not only do bank managers have to choose the optimal financial service product mix (product line specialization in this study) and geographic diversification, but also they need to set lending rates and fees, hedge credit quality and volatility changes, manage their liability structure, forecast loan demand and funds flows and gauge the moods of the equity and debt markets to favorable or unfavorable news so as to increase or protect shareholder value. Given these underlying conditions regarding banks' motivations and their ability to change their portfolios and their position as interest rate takers, we assume that banks operate such that they will only change their portfolio mix to increase profits and maximize shareholder value over a 12-month horizon. As discussed above, the net interest margin is the major source of net income for most banks, and therefore, a strategy of maximizing its value in the short-run may be a reasonable proximate goal to achieving maximum bank profits in the short-run. If risk-neutral pricing is prevalent in financial markets, banks would price loans in a similar way and short-run maximization of the expected value of net interest margins would be a proper bank

objective.[6] However, banks can do better. They can make decisions as to the timing of credit charge-offs, changing portfolios for credit risk purposes and changing asset structure by buying or selling liquid assets (U.S. Government and Agency debt).

To best consider the interest rate sensitivity of net interest margin, we consider net interest margin as a function of interest rates on assets and liabilities and their shares of earning assets at each repricing frequency. Throughout the development of the model, we are assuming that the bank has chosen its product line specialization, thus the assets and liabilities reflect this choice for each bank. This relationship can be formally stated as:

$$NIM_{pt} = NII_{pt} \Big/ EA_{pt} = \left(\sum_{k=1}^{m} y_{kt} EA_{kt} - r_{kt} L_{kt} \right) p \Big/ EA_{pt} \tag{1}$$

where p refers to product line p, NIM_{pt} is net interest margin in t, NII_t is net interest income (interest income less interest expense) in t, EA_{pt} is the amount of interest earning assets in the portfolio in t, y_k is the interest rate on assets of repricing frequency k, EA_k is the amount of earning assets in repricing frequency k, r_k is the interest rate on liabilities for repricing frequency k, and L_k is the amount of liabilities for repricing frequency k. Operationally, the first repricing frequency, for example, would be overnight.

Since *NIM* will be subject to changes in interest rates on earning assets and interest bearing liabilities, changes in investments in earning assets and funding from interest bearing liabilities and the overall investment in earning assets, the continuous change in *NIM*, *dNIM*, is a function of time and bank management portfolio decisions. In general, this can be expressed more formally, assuming continuous time and using (1) for any product line, as follows:

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[6] As pointed out in the introduction, banks in general have been increasing fee income as a way to achieve greater long-run profitability. Fee income is difficult to adjust in the short-run in response to interest rate changes because of its longer term contractual basis. One exception is for credit card banks where fees can be modified at the will of the lender along with interest rates on outstanding balances of accumulated interest and original principal.

$$dNIM_t = \frac{\partial NIM_t}{\partial NII_t} dNII_t + \frac{\partial NIM_t}{\partial EA_t} dEA_t = \frac{dNII_t}{EA_t} - \frac{NII_t}{EA_t^2} dEA_t \qquad (2)$$

where the changes in *NII* and *EA*, *dNII* and *dEA*, are the result of changes in the interest rates, dy_k

and dr_k and bank management decisions on investments in *EA*. The product line index is dropped to

simplify the notation.

Noting that the total derivative of *NII* can be expanded in terms of interest rate, earning asset

and liability changes:

$$dNII_t = \sum_{k=1}^{m} \frac{\partial NII_t}{\partial y_k} dy_k - \frac{\partial NII_t}{\partial r_k} dr_k = \sum_{k=1}^{m} EA_k dy_k + y_k dEA_k - L_k dr_k - r_k dL_k \qquad (3)$$

In this formulation, we assume that interest rate changes are independent of each other, which is not

usually the case. This assumption can be changed by substituting a term structure and credit risk

spread factor model for each interest rate change. For the *NIM* modeling, we will use a more

simplified approach that can accommodate the term structure and credit risk spread effects on *NIM*.

Expressing the interest change effects on *NIM*, we substitute (3) into (2) for *dNII* resulting

in:

$$dNIM_t = \frac{\left(\sum_{k=1}^{m} EA_k dy_k + y_k dEA_k - L_k dr_k - r_k dL_k \right)}{EA_t} - NIM_t \frac{dEA_t}{EA_t} \qquad (4)$$

Note that the final term in (4) is the proportional change in *EA* over the preceding period times the

current period *NIM*. This term is negatively related to the change in *NIM*, implying that holding all

other factors constant, increases in earning assets will tend to decrease the net interest margin. With

respect to the first term in (4), constant interest rates mean that all dy_k and dr_k are zero such that the

proportion of each asset and liability component relative to EA_t would have no effect on the change

in *NIM*. Under these *ceteris paribus* conditions, this term is the ratio of the change in *NII* resulting

from a change in each asset and liability component, holding their respective proportions to *EA*

constant. If dEA_t is positive and each dEA_k and dL_k grows at the same positive rate as earning assets, the effect would be to increase *NII* such that *dNII* is positive as long as NIM_t is positive. The net effect on *NIM* under these conditions is zero.

The implication of this result is important for interpreting the effect of the growth in earning assets on banks' net interest margin. Without advantageous changes in interest rates or changes in the composition of assets and liabilities relative to earning assets, a growth in earning assets will have little effect on *NIM*. Banks should experience an increase in *NII* by practically the same proportion as *EA*. Therefore, management cannot rely solely on growth to increase *NIM* or profitability, but must manage the composition of assets and liabilities to achieve greater *NIM* and ROA, given its expectation of changes in interest rates and term structure.

To complete the model for estimation, changes in interest rates are assumed to be outside the control of management and each is subject to a continuous time, stochastic diffusion process as follows:

$$dy_k = f(y_k, t)dt + \sigma_{y_k} dz_k \tag{5}$$

where σ_{yk} is the standard deviation of changes in y_k, $f(y_k, t)$ is a drift term or mean for dy_k and dz_k is a Weiner process of interest rate changes with repricing frequency k. We assume, for simplicity, that each y_k and r_k follow the same stochastic processes so that dz depends only on the repricing frequency, k. Furthermore, the drift term requires a hypothesis for its value. If it is hypothesized that there is a tendency of regression toward a mean (e.g., Vasicek and Heath-Jarrow-Morton models), the sign of the term will depend on whether interest rates are above or below the mean. Another hypothesis is that the drift term is zero because interest rates follow a random walk once regime shifts are complete (see Ingersoll, 1987, p. 403).[7] Since we do not wish to impose an

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[7] The hypothesis of a random walk is perhaps most appropriate for the period under analysis. From 1984 to present, there have been several regime shifts in interest rate levels due to the substantial and sustained decline of inflation and

interest rate adjustment hypothesis or a term structure hypothesis on bankers' adjustment to interest rate changes, we will allow the data to provide estimates of the effect of interest rate and term structure changes.[8] These interest rate diffusion processes can be substituted into (4) for the final model:

$$dNIM_t = \frac{\left(\sum_{k=1}^{m} EA_k f(y_k,t) + EA_k \sigma_{y_k} dz_k + y_k dEA_k - L_k f(r_k,t) - L_k \sigma_{r_k} dz_k - r_k dL_k \right)}{EA_t} - NIM_t \frac{dEA_t}{EA_t} \quad (6)$$

The drift terms, $f(y_k,t)$ and $f(r_k,t)$, pose an interesting way of viewing the sign of any estimation of the coefficient on EA_k or L_k. If these terms are zero and $E(dz_k)$ is zero, the effect of changes in earning assets is strictly conditioned by interest rate changes.

If interest rates increase for assets and liabilities with repricing frequencies of less than one year, the change in *NIM*, holding all other factors constant, depends on the relative shares of earning assets and liabilities repricing within one year. If short-term liabilities have a greater proportion of EA_t than assets, *dNIM* will be negative and *NIM* will fall in the next period. Note also, that the effect of interest rate volatility on NIM, σ_{yk} and σ_{rk}, will be in the same direction as respective interest rate changes, meaning that higher interest volatility has the same relationship as an increase in interest rates depending on the sign of the repricing gap, the difference between assets and liabilities in the same repricing frequency or cumulative repricing frequencies. Furthermore, the change in *NIM* is inversely related to the level of prior period *NIM* and, since NIM_t is always positive, the rate of change in *EA*, ceteris paribus. Since the rate of change in *EA* can be positive or negative, its sign must be accounted for in estimations.

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shifts in monetary policy. The purpose of our study is not to explain these shifts, but to allow the data to provide parameter estimates of bankers' responses to interest rate changes.

[8] In dealing with data on a quarterly frequency, the imposition of the unbiased expectations hypothesis on interest rate changes and the conjoint assumption of risk-neutral pricing is considered a second order constraint for the purposes of this study. The focus of this study is to estimate bankers' reactions to prior interest rate, term structure and volatility changes and not to impose a particular model. The unbiased expectations hypothesis will be used to help interpret the estimated coefficients since the pricing that results is risk neutral.

By way of comparison, another approach to modeling changes in *NIM* is to employ Ito's lemma by assuming that the change in *NIM* follows a diffusion process as below:

$$dNIM_t = \left(\sum_{k=1}^{m} \frac{\partial NIM_t}{\partial NII_t} \frac{\partial NII_t}{\partial y_k} dy_k - \sum_{k=1}^{m} \frac{\partial NIM_t}{\partial NII_t} \frac{\partial NII_t}{\partial r_k} dr_k \right) + \frac{\partial NIM_t}{\partial t} dt + \frac{1}{2} \sum_{i=1}^{m} \sum_{j=1}^{m} \sigma_{ij} \frac{\partial^2 NIM_t}{\partial x_i \partial x_j} \quad (7)$$

where all variables are as described above, x_i and x_j are interest rates composed of y and r and stated this way in (7) for simplicity, and σ_{ij} is the covariance among all interest rate changes of assets, dy, and liabilities, dr. To expand (7), note that the terms in parenthesis are equivalent to equation (4) where earning assets are allowed to change. The middle term in (7) is the drift of *NIM* over time and can be thought of as a trend in *NIM*. By substituting the diffusion process for interest rates from (5) into (7), the term in parenthesis is equivalent to (6). This approach adds the drift and the second-order stochastic term within the double sum in (7). This final term can be interpreted as the portfolio effect on $dNIM_t$ due to interest rate volatility and correlation – a portfolio risk effect. If interest rates are positively correlated within most interest rate regimes (see Hanweck and Hanweck, 1995 and Hanweck and Shull, 1996) the σ_{ij} are positive and the sign of the double-sum term will depend on the sign of the second derivative of *NIM* with respect to interest rates. This term could be positive or negative depending on whether the interest rates are only for assets or liabilities. For asset terms the sign is negative, for asset and liability terms the sign depends on the weight of assets and liabilities at each repricing period and is likely to be negative for one-year repricing items, and for all liabilities it is likely to be positive. With positive correlations of interest rate changes, we expect that the weight of the terms to be such that changes in volatility will be negatively related to the change in *NIM* for most banks regardless of product line specialization. This result is consistent with the hypothesis expressed in equation (6), but with the correlations of interest rate changes added. Thus, this approach reinforces the role of interest volatility on changes in *NIM*.

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This form of a model of *NIM* change is much less theoretically appealing because it assumes that earning assets and liabilities are almost exclusively stochastic, similar to the assumption of Ho and Saunders (1981), when it is well known that banks can and do change the distribution of assets and liabilities among their repricing buckets substantially from quarter to quarter for strategic purposes, presumably to take advantage of expected future interest rate changes (see Saunders and Cornett, 2003 chapter 9 for this evidence). Thus, we focus our empirical work using the model represented by (6) while taking advantage of the insights of the second model regarding interest rate volatility and correlation by maturity and risk class.

3.2 Credit Risk

Some important factors influencing changes in *NIM* have been left out of the models above in order to achieve simplicity in focusing on interest rate change effects on *NIM*. One important factor, as pointed out by Zarruk and Madura (1992), Angbazo (1997) and Wong (1997), is the effect of credit risk on *NIM*. Angbazo and Wong hypothesized that *NIM* should be positively related to credit risk since greater realized credit risk would mean that banks would respond by charging higher credit premiums. An implication of this hypothesis is that expected increases in credit risk would prompt banks to raise interest rate markups based on these perceived future loan losses.

Although it may be the case in the long run that greater credit risk will lead to higher *NIM* through the pricing of that risk, quarterly or short-run changes in the *NIM* are more likely to respond inversely to increases in credit risk. As in Zarruk and Madura, we argue that when faced with higher uncertainty of loan losses, i.e., an increase in credit risk of their portfolios, risk averse bank managers will shift funds to less default risky, lower yielding assets over the short-term horizon. In addition, bank examiners will put pressure on banks to reduce their exposure to risky credits as loan quality starts to deteriorate. This implies that deterioration in loan quality, indicated by increases in

default spreads in the bond markets and rising loan losses or nonperforming loans relative to earning assets, cause banks to lose interest income from these loans and move funds to less default risky, lower yielding assets. Both effects tend to decrease *NIM* in the short-run, so that decreases in credit quality tend to decrease *NIM*. Furthermore, future economic conditions will be indicated by changes is the term structure as to the likelihood of recession or expansion. A flattening in the term structure indicates a greater likelihood of recession and a related increase in credit risk, each is hypothesized to decrease *NIM*.

4. Data and the empirical model

4.1 Data

Individual bank data for the estimation of these models are obtained from Reports of Condition and Income (Call Reports) collected on a quarterly basis by the FDIC from the first quarter of 1986 to the second quarter of 2003. Data for financial market variables are from Haver Analytics and the Federal Reserve Board of Governors. Bank data prior to the first quarter of 1986 were excluded from the sample because of the existence of Regulation Q that constrained banks' ability to adjust interest rates on deposits in response to changes in market interest rates.[9] In order to exclude spurious financial ratios, we restricted the sample to commercial banks with earning assets of $1 million or more and the earning asset to total asset ratio exceeding 30 percent. We also excluded any observation with missing data points.

The sample was then divided according to the business line specialization and asset size of the bank at the end of each quarter, using a method similar to the FDIC's peer group classification criteria. We make three main alterations to the FDIC peer grouping method to better reflect differences in risk characteristics. First, we break down the FDIC peer group, "commercial lenders"

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[9] The final phasing out of the Regulation Q occurred in the second quarter of 1986.

more finely to better reflect differences in risk characteristics of commercial and industrial (C&I) loan and commercial real estate (CRE) loan portfolio. Second, we separate non-international banks with assets over $10 billion ("large banks") to account for potentially greater reliance on hedging activities that may offset the adverse effects of interest rate shocks. Finally, we use real assets, rather than nominal assets, to classify bank size groups to enable us to compare the asset size over time.[10] Appendix 1 describes the classification method used to create peer groups.[11] Given dissimilarities in their risk characteristics, we expect banks in these different groups to exhibit varying degrees of sensitivity to credit, interest rate and term structure shocks.

Each bank is classified as one of the peer groups in a given quarter, but it may belong to two or more groups throughout the sample period as the bank changes its asset composition and/or business line specialization. For each bank group, we eliminated any bank that did not belong to the group for at least four quarters. The final sample consists of 10,662 institutions that were classified either as large banks or commercial lenders in four or more quarters. We include large banks in the sample to compare their NIM sensitivity to shocks to that of small- and medium-sized banks.

The Call Reports require banks to report cumulative year-to-date income and expenses on a quarterly basis. Reflecting this reporting standard, most studies and quarterly reports by the FDIC and Federal Reserve of bank performance report NIM as an annualized, cumulative value (see the FDIC release of the Quarterly Bank Performance Report, www. FDIC.gov). The use of quarterly cumulative reports tends to smooth changes in NIM, reducing actual quarterly variations. To overcome this problem, we focus on quarterly changes in the net interest margin. For the second quarter through the fourth quarter of each year, we estimate actual income and expenses for the quarter by subtracting the previous quarter cumulative reported values from the current cumulative

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[10] Real assets are computed by dividing nominal assets by CPI-U price level index for the quarter.
[11] We also considered a classification method based on derivative activities; however, data on derivatives are severely limited, particularly for the full sample period, making it difficult to assess the extent to which commercial banks use derivatives for hedging purposes.

reported values. For the first quarter, we use reported income and expenses for the quarter. We then

annualize these values by multiplying each by four. Therefore, all income and expense derived data

are based on adjusted series. The reported earning assets – the denominator of computed ratios --

are the average of ending values for the quarter and the previous quarter.

Three panels in Chart 1 show trends in net interest margins and non-interest income for large

banks and commercial lenders. These charts show a long-term trend of a decline in net interest

margins for most bank types, beginning around the 1992-93 period. It is interesting to note that the

peak year in net interest margins roughly corresponds to the implementation of capital regulation

rules and prompt corrective action specified in FDICIA. Aggregate industry statistics show a

growing importance of non-interest income as a source of bank earnings. The FDIC Quarterly

Banking Profile shows that non-interest income rose from 31 percent of quarterly net operating

revenue in first quarter 1995 to 41 percent in second quarter 2003. However, the median quarterly

non-interest income as a percentage of average earning assets remained mostly stable for most

banks throughout the 1990s.[12]

Large banks did experience a sharp increase in non-interest income over the sample period.

This trend likely reflects earnings and product diversification and a greater reliance on off-balance-

sheet instruments among these banks in response to deregulation, capital regulation and financial

market developments.[13] Rogers and Sinkey (1999) found that banks that are larger and have

smaller net interest margins and fewer core deposits tend to engage more heavily in nontraditional

activities. As Chart 1 shows, large banks saw their non-interest income rise steadily although net

interest income still represents the primary source of their earnings. The net interest margin

fluctuated between 3.5 percent and 4.5 percent of average earning assets for this group of banks.

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[12] DeYoung and Rice (2004) suggests that the long-term increase in non-interest income may have already peaked as
the risk-return tradeoff reached a plateau.
[13] See Angbazo (1997) for the effects of off-balance sheet instruments on net interest margins. Angbazo found a
negative relationship between letters of credit, net securities lent and net acceptances acquired and net interest margins
but a positive relationship between net loans originated/sold and net interest margins.

4.2 Empirical variables

Appendix 2 lists explanatory variables included in our empirical model and their expected

signs. All variables representing financial ratios or interest rates are expressed in annualized

percentage terms. Bank-specific variables and financial market variables included in the empirical

model are derived from the theoretical model of bank behavior presented in Section 3 of this paper.

Table 1 presents descriptive statistics for bank-specific variables for each bank group. In order to

preserve earnings data for an individual institution at a given point in time, we did not adjust the

bank data for mergers and acquisitions that occurred over the sample period. Instead, we screened

the sample for any aberrant data on an individual bank basis. As discussed below, there exist

variations in the value of these bank-specific variables across bank groups as well as within the

given bank group.

4.2.1   Interest Rate Shock Variables

VOL_1Y represents short-term interest rate volatility and it is measured by the standard

deviation of a weekly series of one-year Treasury yields for the quarter. ST_DUMMY is a dummy

variable that takes a value of one if the one-year Treasury yield rose during the quarter and zero if

the yield fell. Chart 2 illustrates a mostly positive but imperfect correlation between the quarterly

short-term interest rate volatility and the level of short-term interest rates. Equation (7) posits that

the coefficients for both VOL_1Y and ST_DUMMY would have a negative sign for most banks.

The duration gap is a widely used measure of interest rate risk that estimates respective

changes in the value of assets and liabilities in response to an interest rate shock. The duration gap

reflects the repricing frequency of assets and liabilities as well as the value of imbedded call

options. Mays (1999) found that differences in the duration gap were one of the key factors behind

NIM variations across Savings and Loans in 1994 -- a period of a sharp increase in short-term

interest rates. Unfortunately, data necessary to calculate the duration gap are not collected in the Call Report for commercial banks, preventing us from using a reported duration gap in our empirical model. Instead, as a proxy for interest rate sensitivity of bank portfolio, we use net short-term assets – the difference between short-term assets and short-term liabilities. We define repricing frequency less than one year as "short-term." STGAP_RAT is net short-term assets as a percentage of earning assets. Although there have been changes in Call Report data items and their definitions over time, we believe that STGAP_RAT is generally comparable over time since many of these changes affected both assets and liabilities. Our definition of STGAP_RAT includes non-maturing liabilities that are discussed more fully below. Chart 3 shows that commercial lender groups have differing degrees of asset-liability mismatch and the degree of mismatch has worsened over time for all commercial lender groups. Holding everything else constant, we expect the coefficient for STGAP_RAT to have a negative sign since longer-term assets have higher yields than shorter-term assets with the same risk characteristics. In addition, we expect the size of STGAP_RAT to have a positive effect on NIM when short-term interest rates rise.

Flannery and James (1984) suggest that deposits with uncertain maturity such as demand deposits, regular savings accounts and small time deposits have an effective maturity longer than one year. Mays (1999) found that thrifts with a high percentage of non-maturing deposits, defined as the sum of demand deposits and regular savings, experienced a positive increase in net interest margins in response to a positive interest rate shock. Although these relationships may have changed in recent years as short-term interest rates have reached one percent and less, we can test for any changes in this structure with models estimated for different time periods. We include NM_RAT, non-maturing deposits as a percentage of earning assets, in the model to proxy for the degree of interest rate sensitivity of the bank's funding from non-maturing deposits. As shown in Table 1, commercial lenders' reliance on non-maturing deposits to fund their lending varies across

and within bank groups.   Based on previous studies, we expect the coefficient for NM_RAT to have a positive sign. In addition, we expect the size of NM_RAT would have a marginal and positive effect on NIM as interest rates rise given documented insensitivity of non-maturing liabilities to interest rate changes (May, 1999).

4.2.2   Term Structure Shock Variables

We include one- to four-quarter lags of DS5Y_1Y, the change in the spread between 5-year and 1-year constant maturity Treasury yields, to proxy for term structure shock.[14] The term structure shock can occur due to expected changes in monetary policy and/or inflationary expectation that are often associated with a business cycle. Indeed, Estrella and Mishkin (1998) show that the steepness of the yield curve predicts recession better than other financial and macroeconomic indicators two to six quarters ahead.[15] Chart 4 shows that the yield curve became inverted prior to the recession in each of the past six recessions since 1960. Logistic regressions (not shown), using 1 for recessions, zero otherwise as the dependent variable, continues to show that the relationship between the term structure spread lagged one to four quarters explains well the occurrence of recession and expansion when the 2001 recession is included in the sample.

Term structure shocks would likely have two reinforcing positive effects on NIM. First, positive term structure shocks would increase NIM as new loans and securities earn higher interest rates than new liabilities that tend to be short-term. However, since a significant portion of existing loans and securities does not reprice within the quarter, the positive effect will take a place with one or more quarter lags. Second, if term structure shocks precede changes in real activity, they can

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[14] Alternatively, we also tested the model with the change in the spread between 10-year and 3-month Treasury yields that produced similar results but somewhat weaker coefficients.
[15] According to Mishkin (1990) and Estrella and Hardouvelis (1991), the term structure is a good predictor of future inflation and real activity.

also proxy for strength in loan demand in subsequent quarters. A positive term structure shock, therefore, should help improve NIM as funds are shifted to higher-yielding assets.

4.2.3   Credit Shock Variables

DLN_AST and DCI_RAT are changes in the loan-to-earning asset ratio and the ratio of C&I loans to earning assets from the prior quarter, respectively. Both variables proxy a size-preserving increase in higher-yielding assets and are expected to be positively related to DNIM_RAT. Table 1 shows that C&I specialists and CRE specialists experienced the largest increases in loan-to-asset ratios during the sample period. All peer groups other than C&I specialists experienced a decline in C&I loan-to-asset ratios on average over the sample period.

We use the spread between the Baa corporate bond and the Aaa corporate bond (CSPRD) yields to proxy for shocks in the credit market due to deterioration in credit quality and/or other credit market disturbances, which may result in reduced liquidity in the market and credit rationing. Previous episodes of these credit events include the Mexican peso crisis in 1995 and the Russian devaluation and default in August 1998 that preceded the near collapse of the Long-Term Capital Management in the fall of 1998. Chart 4 shows that the credit spread tends to spike in recessions as well as in period of market disturbances.[16] In the context of this paper, changes in the credit spread represent changes in perceived credit risk in the market to which bank managers can respond by tightening commercial credit standards and/or increasing a risk premium. As shown in Chart 5, CSPRD is also closely related to the credit risk premium measured by the spread between the C&I loan rate and the intended federal funds rate. The relationship appears to have tightened in the 1990s for C&I loans of all sizes, indicating that banks, both small and large, are better able to price

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[16]   According to Longstaff and Schwartz (1995) and Duffee (1998), corporate bond yields are inversely related to the level of short-term interest rates and the Treasury spread. Pearson correlation coefficient shows strong negative correlation between the short-term interest rate dummy and the credit spread (-0.22) and positive but weak correlation between the term structure and the credit spread (0.07).

perceived changes in credit risk more promptly. The coefficient for CSPRD is expected to have a

negative sign if banks are unable to increase loan rates but ration credit supply in response to an

increase in perceived credit risk.

DNPERF_RAT is ratio of a change in the ratio of nonperforming assets to earning assets

(NPERF_RAT). This variable represents a change in realized credit losses and proxies a "credit

shock." Among commercial lenders, C&I specialists and small commercial loan specialists have

the highest average NPERF_RAT. The median value of DNPERF_RAT is close to zero; however,

there are some institutions within each group with large positive or negative values. As discussed in

the section 3, the coefficient for DPERF_RAT is expected to have a negative sign, if banks are

unable to price credit risk effectively in the short term, as bank managers shift funds to lower-

yielding assets.

4.2.4   Other Institutional Variables

Net interest margin (NIM_RAT) is annualized net interest income for the quarter divided by

average earnings assets. The median DNIM_RAT, the change in NIM_RAT between *t-1* and *t*, is

close to zero for most bank groups although there are institutions experiencing a large change in net

interest margins on a quarter-to-quarter basis. The derivation of the change in NIM presented in

equation (6) of Section 3.1 shows that:

$$dNIM_t = \frac{\left(\sum_{k=1}^{m} EA_k f(y_k,t) + EA_k \sigma_{y_k} dz_k + y_k dEA_k - L_k f(r_k,t) - L_k \sigma_{r_k} dz_k - r_k dL_k \right)}{EA_t} - NIM_t \frac{dEA_t}{EA_t}$$

This suggests that holding the rate of change in EA constant, the change in NIM should be inversely

related to the level of prior period NIM. The coefficient for the lagged value of NIM_RAT is,

therefore, expected to have a negative sign.

DNONII_RAT is an annualized non-interest income for the quarter divided by average earning assets while DSECGL_RAT is annualized security gains and losses for the quarter divided by average assets. Both variables proxy the effects of bank earnings diversification on net interest margins. Signs of these variables could be positive or negative, depending on whether these earnings are substitutes or complementary to NIM.

Finally, LOGAST is the log of total real assets derived as nominal assets deflated by the urban consumer price index (CPI-U). Table 1 shows that there is a negative cross-section relationship between the asset size of the bank and the median NIM_RAT. This would imply that ceteris paribus, the asset size would be also negatively correlated to DNIM_RAT and, therefore, we expect the coefficient for LOGAST has a negative sign. However, as shown from the model development in section 3, a simple change in the scale of operations for an individual bank, should have no effect on changes in net interest margin.

4.2.3 Seasonality

Reported quarterly bank earnings tend to exhibit significant seasonality. In order to control for these seasonal patterns in reported earnings, we include three quarterly dummy variables. QTR2 takes a value of one if the reported period is the second quarter, QTR3 for the third quarter and QTR4 for the fourth quarter.

4.3 Empirical specifications

Our empirical model of net interest margins is a one-way random effects model and is specified as follows:

$$y_{i,t} = \gamma_1 y_{i,t-1} + \beta' x_{i,t-2} + \varphi' z_{t-1} + \tau d_{quarter} + v_{it} \qquad (8)$$

where $i = 1, \ldots, N$, $t = 1, \ldots, T$, $v_{it} = \alpha_i + u_{it}$. α_i, is a random disturbance term unique for the ith observation and both α_i and u_{it} are assumed to be normally distributed. $y_{i,t}$ is the dependent variable, the change in NIM, $x_{i,t-2}$ is a vector of bank-specific explanatory variables, $z_{i,t-1}$ is a vector of financial market explanatory variables and $d_{quarter}$ are quarterly dummies. Finally, γ, β, ϕ and δ are a vector of coefficients. Section 4.2 discussed the expected signs of each of these coefficients.

Following Brock and Franken (2002), bank-specific variables and financial market variables enter the model with two-quarter lags and one-quarter lag, respectively, in order to avoid the potential endogeneity problems that may exist. We estimate the model using the generalized least squares (GLS) technique, based on the estimated disturbance variances. For dynamic random effects models, the GLS estimator is equivalent to the maximum likelihood estimator. The GLS estimator is consistent and asymptotically normally distributed as the number of cross-sectional observations, N, approaches infinity (Hsiao, 2003). N is very large for bank groups in our sample, except for large non-international banks. We address potential heterogeneity and serial correlation problems in model specifications by controlling for the size of the institution, applying cross sectional random effects and adding a lagged value of the dependent variable. As an alternative to GLS estimation, we also tested the mixed model specification, which allows us to explicitly control for heteroscedasticity and serial correlation problems in the unbalanced panel (Littell et. al, 1996). Within the mixed model framework, we tested for a potential bias arising from a number of institutions appearing only for a limited number of quarters, which was not controlled in the GLS specification and found the effect to be insignificant. The results of the mixed model specification were more or less similar to those of the GLS estimation and therefore, they are not reported in this paper.

For each bank group, the empirical model for changes in net interest margins (DNIM_RAT) to be tested is as follows:

$$\begin{aligned}
DNIM\_RAT_{it} = &\ c + \beta_1 * VOL\_1Y_{it-1} + \beta_2 * ST\_Dummy_{it-1} + \beta_3 * STGAP\_RAT_{it-2} + \beta_4 * NM\_RAT_{it-2} \\
&+ \beta_5 * STGAP\_SD_{it-1} + \beta_6 * NM\_SD_{t-1}
\end{aligned}$$ Interest Rate Risk

$$+ \beta_7 * DS5Y\_1Y_{t-1} + \beta_8 * DS5Y\_1Y_{t-2} + \beta_9 * DS5Y\_1Y_{t-3} + \beta_{10} * DS5Y\_1Y_{t-4}$$ Term Structure Risk

$$+ \beta_{11} * DLN\_AST_{t-2} + \beta_{12} * DCI\_RAT_{it-2} + \beta_{13} * DCSPRD_{t-1} + \beta_{14} * DNPERF\_RAT_{it-2}$$ Credit Risk

$$\begin{aligned}
&+ \beta_{15} * LOGAST_{it-1} + \beta_{16} * NIM\_RAT_{it-2} + \beta_{17} * DNIM\_RAT_{it-1} + \beta_{18} * DNONII\_RAT_{it-2} \\
&+ \beta_{19} * DESCGL\_RAT_{t-2} + \beta_{20} * QTR2 + \beta_{21} * QTR3 + \beta_{22} * QTR4
\end{aligned}$$

(9)

5. The results

5.1 Full sample period results

Table 2 summarizes the results of cross sectional time series regression on DNIM_RAT and DROA for bank groups specializing in commercial lending. We applied the Hausman test for the presence of one-way random effects for all groups and could not reject the presence of random effects. Based on these test results, we applied one-way random effects estimation to all groups. The statistical significance of explanatory variables and the size of coefficients for these variables vary considerably across bank groups. The goodness of the fit for the DNIM_RAT model measured by the modified R-square, ranges from 0.23 for commercial loan specialists with real assets greater than $300 million to 0.28 for C&I specialists.

Coefficients for "other" institutional variables have correct signs as predicted by the model. It is interesting to note that the coefficient for DNONII_RAT2 is mostly positive, when significant, suggesting that NIM and non-interest income tended to be a substitute over the full sample period.

Sensitivity to Interest Rate Shocks

The lagged ratio of net short-term assets (STGAP_RAT2) is generally insignificant except for C&I specialists while the lagged ratio of non-maturing deposits to earning assets (NM_RAT2) has a small positive coefficient, when significant. These results suggest, as hypothesized, that the interest rate sensitivity associated with a bank's funding has a significant, positive effect on their net interest margins, regardless of the interest rate environment. Two interaction terms included in the model -- STGAP_SD1 and NM_SD1 – are designed to capture the marginal effect of an increase in net short-term assets (STGAP_RAT2) and non-maturing deposits (NM_RAT2) when short-term interest rates rise (ST_DUMMY1 = 1). Considered together with interaction terms, a negative coefficient for the short-term interest rate dummy variable (ST_DUMMY1) can be interpreted that an increase in short-term interest rates has an adverse effect on the change in net interest margins for banks with no net short-term assets or non-maturing deposits. The two interaction terms, STGAP_SD1 and NM_SD1, are positive and statistically significant for all groups, suggesting that an increase in short-term interest rates has an increasingly positive effect on the change in net interest margins as the proportion of net short-term assets or non-maturing deposits increase.

The economic significance of these coefficients varies across bank groups. For instance, in the case of C&I specialists, holding everything else constant, net interest margins would be 6 basis points lower in the quarter following an increase in the interest rate. A ten-percent increase in STGAP_RAT2 or NM_RAT2 would offset that decline by 4 basis points. In comparison, an increase in the short-term interest rate is followed by a 32-basis point decline in NIM for large banks, with a ten-percent increase in STGAP_RAT2 or NM_RAT2 offsetting this decline by three- and seven-basis points, respectively. Dissimilarities in the sensitivity of NIM to an increase in interest rates between these two bank groups likely reflect inherent differences in the maturity and interest rate terms of their loan portfolio.

Our two measures of interest rate shocks – interest rate volatility (VOL_1Y1) and a short-term interest rate dummy variable (ST_DUMMY) have negative coefficients, when significant. These results seem to contradict the findings of previous research on determinants of net interest margins, which showed that interest rate volatility positively affects the *level* of net interest margins. However, the results are in line with our model that tests for the effect of interest rate volatility on the quarterly *change* in net interest margins. We find that as we hypothesized in the equation (7), given the balance sheet composition of banks in our sample, higher interest rate volatility lowers the change in net interest margins. The coefficients are economically significant and vary widely across bank groups. One percentage-point increase in interest rate volatility, measured by the standard deviation of one-year Treasury yields within the quarter, is followed by about 4- to 6-basis point decline in NIM for most bank groups. The coefficients are significantly larger for C&I specialists that tend to have shorter-term and more default risky assets. One percentage-point increase in interest rate volatility leads to a 23-basis point decline in NIM for C&I specialists. In comparison, short-term interest rate volatility is statistically insignificant for large banks may rely more on off-balance sheet positions to manage their interest rate risk. These results also suggest that most small- to medium-sized commercial lenders are unable to hedge against interest rate risk effectively, at least in the short term.

Term Structure Shock Variables

As hypothesized and consistent with the business cycle literature, the change in the Treasury yield spread affects the variation in net interest margins with a noticeable lag. Coefficients for the three-quarter lagged change in the Treasury yield spread are positive and statistically significant for all groups. For commercial loan specialists, coefficients for two- to four-quarter lagged change in the Treasury yield spread (DS5Y_1Y2, DS5Y_1Y3, and DS5Y_1Y4) are significantly positive.

Ceteris paribus, a 100-basis point increase in the yield spread boost NIM for commercial loan specialists by about four-basis points two quarters after the initial shock, by seven- basis points after three quarters and four basis points after four quarters. In all cases, coefficients were the largest for the three-quarter lagged change in the Treasury yield spread.

Credit Shock Variables

The coefficient for the lagged value of the change in the loan-to-earning assets ratio is significant but negative C&I specialists and commercial loan specialists with real assets less than $50 million and consumer loan specialists while positive for large banks and commercial loan specialists with real assets greater than $50 million. Based on the interpretation of this variable as a proxy for a size preserving increase to higher earning assets, a negative sign may imply that these banks attract new loans by offering lower rates and/or they do not price credit risk of new loans correctly.

The lagged value of the change in the C&I loan ratio (DCI_RAT2) have significantly negative coefficients for commercial loan specialists with real assets over $300 million but insignificant for others. The negative coefficient is contrary to prior expectations. It may reflect exogenous variables not specified in the model such as the competitive market landscape affecting loan pricing. Alternatively, for this group of banks, a trade-off and diversification benefit may exist between an expansion to higher-yielding assets and higher risk.

The lagged value of a change in the credit spread (DCSPRD1) has a negative and significant coefficient for most bank groups, suggesting that banks tighten commercial credit standards following credit market disturbances. Despite that banks do charge a higher risk premium in response to higher credit risk, as shown in Chart 5, commercial lenders seem generally unable to fully price credit risk and rely more on credit rationing. The effect of changes in the credit spread

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appears to be economically significant for many bank groups although there are significant variations across groups. For instance, it is estimated that a 100-basis point increase in the credit spread subsequently reduces NIM by 5 basis points for CRE specialists and 16 basis points for C&I specialists.

The coefficient for the lagged value of the change in the non-performing asset ratio (DNPERF_RAT2) is negative, when significant. In most cases, credit quality deterioration, measured by DNPERF_RAT2 has considerably weaker economic significance than the forward-looking loan quality variable (DCSPRD1). The results of the credit shock variables suggest that, as we hypothesized in Section 3, banks are unable to effectively price an increase in credit risk and managers respond to this increase in the short term by shifting funds to less default risky and lower yielding assets.

5.2 Sub-sample period results

Over our sample period, the banking industry underwent a series of major legislative and regulatory changes, a period of a severe thrift and banking crises, and an unprecedented consolidation movement. Presumably these changes have had numerous effects on the way banks operate. It is therefore reasonable to assume that earnings sensitivity to interest rate and other shocks would vary across different regulatory and economic regimes. As we discussed in Section 1, we primarily focus on effects of three key legislative changes during this period – DIDMCA, FDICIA and Riegle-Neal. These pieces of legislation are important to the banking industry because they spurred price competition for deposits that led to less volatility in bank lending, improved the capital position of the banks and allowed geographic and earnings diversification and changed the general competitive landscape.

In order to test the effects of these changes on sensitivity of bank earnings, we test our model in four different sub-sample periods – 1986 to 1988, 1989 to 1991, 1992 to the second quarter of 1997 and the third quarter of 1997 to the second quarter of 2003. We separate the first two periods in order to separate the post-Regulation Q period from the exogenous effect of a banking crisis, recession and credit crunch in the 1989-1991 period, which would have distorted the sensitivity of bank earnings to interest rate and other shocks. The Riegle-Neal provision that allows bank mergers across state lines became effective on June 1, 1997. As a result, we would expect some notable differences in earnings sensitivity to interest rate and other shocks in the last sub-sample period from previous periods.   We present the estimation results of the models for the sub-sample periods for net interest margin in Table 3A through Table 3C.[17] In this section, we discuss within-group variations across sub-sample periods, focusing primarily on variables that exhibit the greatest variations.

We expect that the progressive changes to greater competition in banking may have increased the ability of banks to adjust loan and deposit rates more readily to change in the economic environment. Accordingly, this may likely have smoothed changes in net interest margin and reduced the effect of interest rate changes on net interest margins. In contrast, banks may have chosen to specialize more in the face of greater competition, taking advantage of clientele more suitable to the bank and avoiding competition with larger banking companies. This may have resulted in less flexible portfolio structures.

Interest Rate Shocks

As with the full sample, lagged values of net short-term assets (STGAP_RAT2) have generally negative coefficients, when significant while lagged values of non-maturing deposits

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[17] International and credit card banks have an insufficient number of observations to analyze sub-period variations and as a result, left out from this section. In other cases, such as C&I lenders, patterns of their within-group variation are similar to other groups presented in the paper, so we do not report the results to avoid duplication.

(NM_RAT2) have significantly positive coefficient, when significant. With an exception of large banks, the coefficient for interest rate volatility shifts from being positive in the 1992 – 1997:Q2 period to negative in the 1997:Q3 – 2003:Q2 period. Two factors may potentially explain these results. This may reflect differences in the market interest rate environment between the two periods if interest rate volatility actually captures the movement in the short-term interest rate. However, our model includes a dummy variable for the change in short-term interest rates (ST_DUMMY1) that controls for the change in short-term interest rates. In addition, if the result captures the difference in the interest rate environment, that should also apply to large banks. An additional explanation is that an increase in market competition in the later period may have constrained the banks' ability to factor interest rate volatility in their pricing decision. These results also imply that despite diversification, most banks are still unable to hedge interest rate risk effectively using off-balance sheet instruments.[18]

Term Structure Shocks

Our results show that most banks remain vulnerable to term structure shocks in the post-Riegle Neal era. Many banks faced significant financial difficulties in earlier periods and, therefore, their earnings performance was primarily determined by bank-specific factors rather than market factors. Therefore, a more useful comparison may be that of coefficients between the 1992-1997:Q2 period and the 1997:Q3-2003:Q2 period. The coefficient for the one-quarter lagged yield spread (DS5Y_1Y1) changed the sign from positive in the 1992-1997:Q2 period to negative in the more recent period. The effect of the change in the yield spread generally faded after one- or two-quarters in the 1992-1997:Q2 period; however, the change in the yield spread continued to affect NIM up to four quarters after the initial shock in the most recent period. These results suggest that

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[18] Our results show that large banks are better able to hedge interest rate volatility. The coefficient for interest rate volatility is positive for large non-international banks in the most recent period. We did not present sub-sample results for large non-international banks due to the small size of N in earlier periods.

changes in narrowing of the Treasury yield spread still has lingering and positive effects on net interest margins, but with a greater lag than previously. Our results may reflect changes in the maturity composition of banks' balance sheet shown in Chart 3.

Credit Shocks

Many banks appear to be better able to price expected changes in credit risk in the more recent period than previously. The coefficient for the change in the credit spread (DCSPRD1) was generally negative in the 1992-1997:Q2 period but was positive in the most recent period. Coefficients for the lagged value of non-performing loan ratio was insignificant for all groups in the most recent period. We can view the lagged change in the credit spread as the anticipated change in credit risk and the lagged change in the non-performing asset ratio as the actual change in credit risk. Together, these results suggest that banks may have become more efficient in pricing credit risk in the more recent period as market competition increased while regulatory restrictions relating to loan rates eased. These results also suggest that in a more recent period, banks are relying more on pricing rather than quantity control in response to heightened credit risk. If an increase in credit risks primarily results in tighter commercial credit standards or the curtailment of loan supply, as it was in the case during the credit crunch in the 1980s and 1990s, greater credit spreads would depress earnings. The change in credit spread, in the most recent period, leads to improvement in NIM. These results suggest that banks have been able to respond to higher credit risk with higher loan rates through risk-based pricing and other tools.

6. Conclusion

This paper presents an empirical model that captures net interest margin dynamics as banks face credit, interest rate and term structure shocks over the business cycle. The paper attempts to

enhance our understanding of the complex relationship between interest rate, real activity and bank performance using a large micro-level data set. The models estimated and results reported in this paper are a comprehensive contribution to understanding the systematic effects of changes in interest rate and credit risks on bank NIM, one of the principal elements of bank cash flows, and after-tax earnings. We show that net interest margins for commercial banks in different bank groups, defined in terms of the product line specialization and asset size of each bank at the end of each quarter, usually respond in a predictable yet dissimilar way to shocks. These differences likely reflect a variation in the asset composition, in terms of repricing frequencies and inherent credit risks, across these groups.

We present the results of cross section time series random effects regression estimation that show changes in net interest margins between the two quarters are sensitive to credit, interest rate and term structure shocks for most bank groups, but by varying degrees. In general, large banks seem to be vulnerable to credit shocks, but less sensitive to interest rate or term structure shocks. We present evidence that banks continue to be sensitive to credit, interest rate and term structure shocks in the post Riegel-Neal regulatory environment. Term structure shocks affect this group of banks with greater lags in the recent period than before. At the same time, banks seem to be more constrained in their ability to factor in interest rate volatility than previously, possibly due to increased competition in the general lending arena. Finally, our results suggest that many banks appear to be able to price actual and expected credit risk more efficiently than in earlier periods.

Future research may expand these models to other earnings components such as non-interest income and security gains and losses to independently model interest rate risk in each component of bank earnings. With new banking activities such as securitization that allow banks to move certain assets off balance sheet, certain components of non-interest income have likely become more sensitive to interest rate shocks. If various earnings components for certain bank groups behave

similarly to unanticipated shocks over time, benefits these banks derive from earnings diversification would be more limited than otherwise. Future studies may also want to explicitly model the competitive market structure in which the bank operates and its effect on banks' abilities to respond to unanticipated shocks. The local competitive landscape may have a particularly significant effect on small locally-based banks. However, lack of data on bank loan concentrations in local areas continues to challenge researchers in this endeavor. Finally, developing a new and more refined methodology to classify the banking industry into unique product line specializations would enhance our understanding of various business models and their response to changes in interest rates, the term structure and credit and economic conditions.

APPENDIX 1: Bank Grouping Descriptions

Bank Grouping	Description
Large Banks & Commercial Lenders	
Large banks	Non-international banks with real assts over $10 billion
Commercial and industrial (C&I) specialists	Banks with C&I loans in excess of 25 percent of total assets
Commercial real estate (CRE) specialists	Banks with CRE loans in excess of 25 percent of total assets
Commercial loan specialists	Banks with the sum of C&I and CRE loans in excess of 25 percent of total assets that are not classified as C&I or CRE specialists. The group is further broken down into three subgroups by the real asset size – less than $50 million, between $50 million and $300 million and greater than $300 million in real assets.
Other FDIC Peer Groups	
International banks	Banks with real assets over $10 billion and foreign assets in excess of 25 percent of total assets
Agricultural banks	Banks with the sum of agricultural and farmland-secured loans in excess of 25 percent of total assets
Credit card specialists	Banks with the sum of credit card loans, credit card-related asset backed securities, and credit card loans sold and securitized with recourse in excess of 50 percent of total assets
Mortgage loan specialists	Banks with the sum of mortgage loans and mortgage-backed securities in excess of 50 percent of total assets.
Consumer loan specialists	Banks with the sum of consumer loans and residential real estate loans in excess of 50 percent that are not classified as credit card specialists or mortgage specialists.
Other small specialists	Banks with the loan-to-asset ratio less than 40 percent and real assets less than $1 billion.
Small non-specialist banks	Banks with real assets less than $1 billion and not in other groups. The group is further broken down into three subgroups by the real asset size – less than $50 million, between $50 million and $300 million and greater than $300 million in real assets.
Mid-tier non-specialist banks	Banks with real assets between $1 billion and $10 billion and not in other groups.

APPENDIX 2: Explanatory Variable Description

Variable Name	Description	Expected Sign
Interest Rate Risk		
vol_1y1	Standard deviation of one-year Treasury yields (weekly series) in *t-1*	-
st_dummy1	1 if the one-year Treasury yield increased between *t* and *t-1*; 0 if the one-year Treasury yield decreased between *t* and *t-1*;	-
stgap_rat2	The ratio of assets with remaining maturity less than one year *less* liabilities with remaining maturity less one year (net short-term assets) to earning assets in *t-2*	-
nm_rat2	The ratio of non-maturing deposits (transactional deposits, money market and regular savings) to earning assets in *t-2*	+
stgap_sd1	Interaction term between stgap_rat2 and st_dummy1	+
nm_sd1	Interaction term between nm_rat2 and st_dummy1	+
Term Structure Risk		
ds5y_1y1	Difference in 5-year and 1-year Treasury yield spreads between *t-2* and *t-1*	+
ds5y_1y2	Difference in 5-year and 1-year Treasury yield spreads between *t-3* and *t-2*	+
ds5y_1y3	Difference in 5-year and 1-year Treasury yield spreads between *t-4* and *t-3*	+/-
ds5y_1y4	Difference in 5-year and 1-year Treasury yield spreads between *t-5* and *t-4*	+/-
Credit Risk		
dln_ast2	Difference in the loan-to-earning assets ratio between *t-3* and *t-2*	+
dci_rat2	Difference in the commercial and industrial (C&I) loans to earning assets ratio between *t-3* and *t-2*	+
dcsprd1	Difference in Baa-rated and Aaa-rated corporate bond yield spreads between *t-2* and *t-1*	-

Variable Name	Description	Expected Sign
dnperf_rat2	Difference in the nonperforming assets to earning assets ratio between *t-3* and *t-2*	-

Other Institutional Variables

Variable Name	Description	Expected Sign
Logast2	Log of total assets in *t-2*	-
nim_rat2	Annualized quarterly net interest income divided by average earning assets (net interest margin) – *two quarter lag (t-2)*	-
Roa2	Annualized quarterly net income divided by average earning assets (return on average earning assets) – *two quarter lag (t-2)*	-
dnim_rat1	Difference in net interest margins between *t-2* and *t-1*	-
droa1	Difference in the return on average earning assets between *t-2* and *t-1*	-
dnonii_rat2	Difference in the non-interest income to average earning assets ratio between *t-3* and *t-2*	+/-
dsecgl_rat2	Difference in the security gains/losses to average earning assets ratio between *t-3* and *t-2*	+/-

Seasonal Dummy

Variable Name	Description	Expected Sign
qtr2	1 if the reporting period is the second quarter of the year; 0 if otherwise	+/-
qtr3	1 if the reporting period is the third quarter of the year; 0 if otherwise	+/-
qtr4	1 if the reporting period is the fourth quarter of the year; 0 if otherwise	+

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Table 1: Descriptive Statistics by Bank Groupings

Variables included in this table are net interest income to average earning assets (NIM_RAT), return on average assets (ROA), non-interest income to average earning assets (NONII_RAT), security gains/losses to average earning assets (SECGL_RAT), loan-to-earning asset ratio (LN_AST), C&I loans to earning asset ratio (CI_RAT), non-performing asset to earning asset ratio (NPERF_RAT), net short-term assets to earning asset ratio (STGAP_RAT) and log of total assets (LOGAST). All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. See Appendix 2 for further details on variables.

Variables	Large Non-Internatinoal Banks					C&I Specialists				
	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	4.08	4.01	1.29	-0.02	17.60	5.04	4.89	1.55	-19.85	35.60
dnim_rat	-0.01	-0.02	0.58	-7.20	10.47	-0.01	0.00	0.85	-40.66	29.07
roa	1.33	1.40	1.49	-26.70	12.82	0.23	0.99	4.21	-199.12	39.53
droa	-0.01	0.00	1.48	-22.79	14.95	-0.08	0.01	4.60	-195.20	206.50
nonii_rat	2.86	2.00	3.25	-4.35	28.33	1.45	0.96	6.15	-14.87	512.58
dnonii_rat	0.01	0.01	1.39	-16.04	18.52	0.02	0.01	1.57	-57.08	87.11
secgl_rat	0.05	0.01	0.27	-4.80	2.98	0.04	0.00	0.31	-11.60	9.08
dsecgl_rat	0.00	0.00	0.35	-4.77	4.80	0.00	0.00	0.42	-11.79	17.61
ln_ast	75.16	76.01	13.61	7.67	105.17	76.02	76.64	10.82	28.62	123.13
dln_ast	0.08	0.08	4.26	-39.71	49.88	0.56	0.49	5.14	-56.57	88.09
ci_rat	22.33	21.48	11.79	0.00	69.96	37.27	34.62	9.19	25.32	101.48
dci_rat	-0.11	-0.03	2.08	-17.42	22.52	0.46	0.33	4.34	-52.81	88.67
nperf_rat	1.50	0.91	1.77	0.05	24.62	2.69	1.40	3.85	-1.83	58.87
dnperf_rat	0.02	-0.01	0.44	-2.08	7.11	0.15	0.00	1.40	-24.26	46.22
stgap_rat	-31.86	-33.59	16.72	-76.31	59.16	-25.24	-26.27	18.38	-109.26	101.81
nm_rat	45.14	44.66	16.32	0.02	100.37	53.04	53.09	17.65	0.00	125.87
logast	16.77	16.62	0.61	16.12	19.70	11.17	10.90	1.41	7.21	16.12

Variables	CRE Specialists					Commerical Loan Specialists -- Real Assets <=$50 Mil.				
	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	4.97	4.88	1.22	-13.11	34.10	5.00	4.91	1.06	-17.18	32.64
dnim_rat	-0.02	-0.01	0.66	-25.93	29.51	0.00	0.00	0.64	-23.28	23.05
roa	0.90	1.18	2.39	-122.89	44.62	0.60	1.05	2.79	-153.73	41.66
droa	-0.02	0.02	2.46	-116.79	88.58	0.01	0.03	3.19	-147.59	137.16
nonii_rat	1.11	0.85	1.33	-21.40	55.17	1.18	0.95	1.19	-18.38	58.04
dnonii_rat	0.00	0.00	0.86	-46.51	50.92	0.00	0.00	1.00	-122.81	27.21
secgl_rat	0.02	0.00	0.25	-23.50	9.15	0.03	0.00	0.30	-15.89	16.65
dsecgl_rat	0.00	0.00	0.32	-23.50	17.78	0.00	0.00	0.41	-16.47	16.58
ln_ast	76.30	76.85	10.43	31.71	123.23	69.41	69.90	10.72	24.46	111.15
dln_ast	0.36	0.39	4.30	-37.04	71.45	0.17	0.27	4.51	-42.58	40.99
ci_rat	12.34	11.88	6.68	0.00	37.87	17.01	16.96	6.04	0.24	42.77
dci_rat	-0.22	-0.05	2.41	-68.60	23.69	-0.08	0.00	2.75	-58.08	29.11
nperf_rat	1.94	0.82	3.54	-11.85	63.62	2.27	1.15	3.72	-1.63	204.54
dnperf_rat	0.07	0.00	1.08	-45.86	47.35	0.03	0.00	1.14	-22.46	34.97
stgap_rat	-32.03	-32.99	18.44	-166.68	91.77	-33.44	-34.63	17.95	-136.06	54.67
nm_rat	51.25	50.69	17.09	0.00	203.15	53.14	51.92	15.26	0.00	157.84
logast	11.32	11.22	1.05	7.08	16.07	10.16	10.24	0.48	7.30	10.82

Variables	Commerical Loan Specialists -- Real Assets $50 - 300 Mil.					Commerical Loan Specialists -- Real Assets >$ 300 Mil.				
	Mean	Median	St. Dev.	Min.	Max	Mean	Median	St. Dev.	Min.	Max
nim_rat	4.66	4.60	0.87	-11.87	21.74	4.41	4.40	0.82	-1.10	18.81
dnim_rat	-0.01	0.00	0.47	-17.81	15.64	-0.01	0.00	0.43	-15.36	14.53
roa	1.04	1.22	1.60	-66.22	45.12	1.05	1.25	1.47	-42.41	22.03
droa	0.00	0.01	1.83	-63.16	63.17	-0.01	0.01	1.53	-40.09	42.06
nonii_rat	1.08	0.89	1.32	-17.46	67.89	1.54	1.28	1.71	-3.94	37.38
dnonii_rat	0.01	0.00	0.79	-52.60	61.78	0.01	0.01	0.68	-17.59	20.29
secgl_rat	0.04	0.00	0.27	-14.72	9.34	0.04	0.00	0.28	-5.92	7.42
dsecgl_rat	0.00	0.00	0.36	-15.62	14.72	0.00	0.00	0.35	-8.36	6.80
ln_ast	69.07	69.66	10.71	26.97	103.53	71.78	72.69	10.92	28.39	102.15
dln_ast	0.08	0.24	3.44	-47.88	50.05	0.05	0.22	3.34	-37.12	47.62
ci_rat	15.59	15.19	5.88	0.23	35.04	17.30	17.32	5.95	1.47	56.99
dci_rat	-0.09	-0.02	2.07	-43.16	22.67	-0.09	-0.01	1.81	-24.69	18.78
nperf_rat	1.64	0.89	2.43	-0.97	65.80	1.64	0.95	2.12	-2.23	40.25
dnperf_rat	0.02	-0.01	0.73	-27.23	31.41	0.02	-0.01	0.67	-22.83	20.87
stgap_rat	-36.91	-37.88	16.30	-163.32	56.15	-38.44	-39.19	15.08	-135.34	44.88
nm_rat	52.67	51.40	13.23	0.01	141.77	52.35	51.74	12.97	0.00	176.65
logast	11.56	11.49	0.48	10.82	12.61	13.79	13.52	0.95	12.61	16.12

Table 2: Cross-sectional Time Series Regression with Random Effects 1986:Q1 – 2003:Q2

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively. Hausman test rejected random effects for "international" institutions; therefore, results for international banks represent an estimate using cross-sectional time series regression with fixed effects.

	Large Banks	C&I Specialists	CRE Specialists	Commerical Loan Specialists <=$50 mil.	Commerical Loan Specialists $50 - $300 mil.	Commerical Loan Specialists >$300 mil.
Intercept	1.2475 ***	2.2551 ***	2.0949 ***	1.2048 ***	1.5601 ***	0.9470 ***
	(0.3965)	(0.0919)	(0.0551)	(0.0902)	(0.0778)	(0.087)
Interest Rate Risk						
vol_1y1	0.1489	-0.2287 ***	-0.0515 **	-0.0864 ***	-0.0597 ***	-0.0165
	(0.1164)	(0.0357)	(0.0225)	(0.0239)	(0.0164)	(0.0272)
st_dummy1	-0.3171 ***	-0.0616 **	-0.0741 ***	-0.0971 ***	-0.0764 ***	-0.0937 ***
	(0.0743)	(0.0251)	(0.0148)	(0.0192)	(0.0151)	(0.0257)
stgap_rat2	-0.0023	0.0017 ***	-0.0001	-0.0002	-0.0001	-0.0005
	(0.0015)	(0.0004)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
nm_rat2	0.0009	0.0102 ***	0.0070 ***	0.0072 ***	0.0063 ***	0.0046 ***
	(0.0017)	(0.0005)	(0.0003)	(0.0003)	(0.0003)	(0.0005)
stgap_sd1	0.0028 **	0.0040 ***	0.0037 ***	0.0031 ***	0.0028 ***	0.0024 ***
	(0.0015)	(0.0005)	(0.0003)	(0.0003)	(0.0002)	(0.0004)
nm_sd1	0.0074 ***	0.0037 ***	0.0043 ***	0.0040 ***	0.0035 ***	0.0030 ***
	(0.0015)	(0.0005)	(0.0003)	(0.0004)	(0.0003)	(0.0005)
Term Structure Risk						
ds5y_1y1	0.0395	-0.0791 ***	-0.0019	-0.0276 **	0.0092	0.0065
	(0.0531)	(0.0167)	(0.0101)	(0.0117)	(0.0079)	(0.0132)
ds5y_1y2	0.0764	0.0007	0.0155	0.0341 ***	0.0464 ***	0.0424 ***
	(0.0541)	(0.0182)	(0.0102)	(0.0123)	(0.0084)	(0.0139)
ds5y_1y3	0.1390 ***	0.0670 ***	0.0666 ***	0.0727 ***	0.0823 ***	0.0571 ***
	(0.0534)	(0.0183)	(0.0102)	(0.0124)	(0.0084)	(0.0139)
ds5y_1y4	-0.0296	0.0173	0.0270 ***	0.0272 **	0.0297 ***	0.0519 ***
	(0.0519)	(0.0162)	(0.0098)	(0.0111)	(0.0076)	(0.0126)
Credit Risk						
dln_ast2	0.0085 ***	-0.0030 ***	-0.0006	-0.0013 **	0.0009 *	0.0033 ***
	(0.0028)	(0.0009)	(0.0005)	(0.0006)	(0.0006)	(0.001)
dci_rat2	-0.0003	0.0011	-0.0006	0.0012	0.0008	-0.0058 ***
	(0.0062)	(0.0011)	(0.0009)	(0.0009)	(0.0009)	(0.0018)
dcsprd1	0.0739	-0.1627 ***	-0.0472 **	-0.0836 ***	-0.0665 ***	-0.0426
	(0.1174)	(0.0423)	(0.0224)	(0.028)	(0.0187)	(0.031)
dnperf_rat2	-0.0427 **	-0.0134 ***	-0.0147 ***	-0.0049 **	-0.0118 ***	-0.0211 ***
	(0.0166)	(0.0032)	(0.0022)	(0.0023)	(0.0025)	(0.0047)
Other Institutional Variables						
logast1	-0.0085	-0.0880 ***	-0.1048 ***	-0.0312 ***	-0.0625 ***	-0.0155 ***
	(0.0225)	(0.0073)	(0.0043)	(0.0085)	(0.0064)	(0.0057)
nim_rat2	-0.3146 ***	-0.3759 ***	-0.2917 ***	-0.2807 ***	-0.2771 ***	-0.2461 ***
	(0.0189)	(0.0048)	(0.0032)	(0.0039)	(0.0035)	(0.0059)
dnim_rat1	-0.5301 ***	-0.5755 ***	-0.5378 ***	-0.5222 ***	-0.5173 ***	-0.4909 ***
	(0.0223)	(0.0051)	(0.0038)	(0.0044)	(0.004)	(0.0072)
dnonii_rat2	0.0233 ***	0.0003	0.0055 **	0.0043 **	-0.0008	-0.0106 ***
	(0.008)	(0.0022)	(0.0023)	(0.002)	(0.0023)	(0.0041)
dsecgl_rat2	0.0089	-0.0153 *	-0.0124 *	0.0092	0.0014	-0.0004
	(0.0318)	(0.0086)	(0.007)	(0.0058)	(0.0045)	(0.0078)
Seasonal Dummy						
qtr2	0.0840 **	0.1325 ***	0.1615 ***	0.1638 ***	0.1393 ***	0.0863 ***
	(0.0368)	(0.0116)	(0.0071)	(0.0078)	(0.0053)	(0.0089)
qtr3	0.0942 **	0.1568 ***	0.1835 ***	0.1903 ***	0.1592 ***	0.1302 ***
	(0.039)	(0.0128)	(0.0075)	(0.0083)	(0.0056)	(0.0094)
qtr4	0.0842 **	0.1177 ***	0.1049 ***	0.1011 ***	0.0942 ***	0.0877 ***
	(0.0377)	(0.0121)	(0.0073)	(0.0079)	(0.0054)	(0.0089)
# of Cross Sections	89	2378	3564	3220	3300	917
Time Series Length	70	70	70	70	70	70
R-Square	0.25	0.28	0.26	0.25	0.26	0.23

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 3A: Cross-sectional Time Series Regression with Random Effects
Sub-sample Periods – Large Non-International Banks and C&I Specialists

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively.

	Large Non-International Banks				C&I Specialists			
	1986-1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2	1986-1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2
Intercept	3.6741	-1.1194	-2.5718 ***	2.3762 ***	3.4732 ***	4.0233 ***	2.1438 ***	2.0856 ***
	(3.8621)	(1.9716)	(0.7328)	(0.6392)	(0.1995)	(0.2388)	(0.1851)	(0.2267)
Interest Rate Risk								
vol_1y1	0.4634	0.1236	0.0073	0.4592 *	0.1891	-0.6808 ***	0.2097 ***	-0.6480 ***
	(0.6178)	(0.4532)	(0.1334)	(0.2627)	(0.1936)	(0.0603)	(0.0603)	(0.1091)
st_dummy1	0.2232	-0.4376 **	-0.3518 ***	-0.3322 ***	-0.3189 ***	-0.1176	0.0210	0.0613
	(0.2243)	(0.2054)	(0.0862)	(0.1273)	(0.0602)	(0.083)	(0.0385)	(0.0489)
stgap_rat2	-0.0057	0.0050	0.0027	-0.0045 *	-0.0006	0.0001	-0.0013	0.0013
	(0.0061)	(0.0036)	(0.002)	(0.0024)	(0.0009)	(0.0011)	(0.0008)	(0.0009)
nm_rat2	0.0071	0.0130 **	0.0079 ***	-0.0049 *	0.0158 ***	0.0182 ***	0.0065 ***	0.0059 ***
	(0.0087)	(0.0051)	(0.0026)	(0.0029)	(0.0012)	(0.0015)	(0.0009)	(0.0012)
stgap_sd1	0.0047	0.0030	0.0039 *	0.0030	0.0039 ***	0.0060 ***	0.0036 ***	0.0051 ***
	(0.0048)	(0.0033)	(0.002)	(0.0024)	(0.001)	(0.0011)	(0.0008)	(0.0009)
nm_sd1	0.0021	0.0074 **	0.0071 ***	0.0079 ***	0.0046 ***	0.0077 ***	0.0028 ***	0.0041 ***
	(0.0047)	(0.0033)	(0.0019)	(0.0024)	(0.001)	(0.0012)	(0.0007)	(0.0009)
Term Structure Risk								
ds5y_1y1	-1.2632 *	0.4180 *	0.0468	-0.0228	-0.6847 ***	-0.3796 ***	0.0964 **	-0.1240 ***
	(0.6655)	(0.2457)	(0.0901)	(0.0821)	(0.1628)	(0.1058)	(0.041)	(0.034)
ds5y_1y2	1.0073	-0.4855	0.0130	0.1252	0.6476 ***	0.1970	0.0437	0.1604 ***
	(0.9404)	(0.6619)	(0.0868)	(0.0945)	(0.2418)	(0.2845)	(0.0413)	(0.04)
ds5y_1y3	-0.2926	0.2895	0.1705 **	0.1697 **	0.0827	0.0588	0.0301	0.0670 *
	(0.7308)	(0.4227)	(0.0693)	(0.0856)	(0.1827)	(0.1832)	(0.0325)	(0.0372)
ds5y_1y4	-0.6598 **	0.3142 *	-0.0335	-0.0563	-0.0582	-0.3041 ***	-0.0108	-0.1413 ***
	(0.3063)	(0.1831)	(0.0626)	(0.1001)	(0.0744)	(0.0752)	(0.0292)	(0.0444)
Credit Risk								
dln_ast2	0.0258 **	-0.0001	-0.0069 *	0.0111 ***	-0.0034 **	0.0040 *	0.0008	-0.0057 ***
	(0.0114)	(0.0076)	(0.0039)	(0.004)	(0.0016)	(0.0021)	(0.0016)	(0.0019)
dci_rat2	-0.0518 **	0.0035	0.0147 **	0.0060	0.0003	-0.0026	-0.0054 ***	0.0052 **
	(0.0215)	(0.0138)	(0.0071)	(0.0098)	(0.0019)	(0.0024)	(0.002)	(0.0022)
dcsprd1	-1.7020	0.4496	-0.2436	-0.0348	-0.7009 ***	-0.1200	0.0397	0.0827
	(1.0396)	(0.2957)	(0.3376)	(0.1867)	(0.2714)	(0.1258)	(0.1546)	(0.0792)
dnperf_rat2	-0.2003 ***	-0.0008	-0.0100	-0.1320	-0.0248 ***	-0.0145 **	0.0025	0.0099
	(0.0698)	(0.0299)	(0.0369)	(0.0935)	(0.0049)	(0.0069)	(0.006)	(0.0106)
Other Institutional Variables								
logast1	-0.1742	0.1004	0.2205 ***	-0.0351	-0.1485 ***	-0.1454 ***	-0.0813 ***	-0.0702 ***
	(0.2306)	(0.1157)	(0.0407)	(0.0369)	(0.0148)	(0.0182)	(0.014)	(0.0188)
nim_rat2	-0.4724 ***	-0.2753 ***	-0.3286 ***	-0.4351 ***	-0.6009 ***	-0.6608 ***	-0.3430 ***	-0.3158 ***
	(0.1002)	(0.0704)	(0.0384)	(0.0299)	(0.0109)	(0.0122)	(0.0104)	(0.0087)
dnim_rat1	-0.5925 ***	-0.4722 ***	-0.4638 ***	-0.6290 ***	-0.7285 ***	-0.7963 ***	-0.5070 ***	-0.4324 ***
	(0.0896)	(0.0687)	(0.0454)	(0.0302)	(0.0092)	(0.0101)	(0.012)	(0.011)
dnonii_rat2	0.2182 ***	-0.0679	0.0014	0.0193 *	0.0109 **	0.0160 ***	-0.0044	-0.0097 *
	(0.0666)	(0.0453)	(0.0242)	(0.01)	(0.005)	(0.0061)	(0.0032)	(0.005)
dsecgl_rat2	0.0136	-0.0205	-0.0073	0.0063	-0.0153	0.0230	-0.0398 ***	-0.0018
	(0.0744)	(0.0991)	(0.038)	(0.0541)	(0.0117)	(0.0338)	(0.015)	(0.0358)
Seasonal Dummy								
qtr2	0.0922	-0.0887	0.0772 *	0.0924	0.0545 **	0.1925 ***	0.1761 ***	0.1624 ***
	(0.1118)	(0.0999)	(0.0454)	(0.0649)	(0.0245)	(0.0411)	(0.0216)	(0.0269)
qtr3	0.8923 **	0.1855	0.0408	0.1014	0.6046 ***	0.0502	0.1807 ***	0.0503
	(0.3684)	(0.2462)	(0.0407)	(0.0803)	(0.0933)	(0.1053)	(0.0197)	(0.0341)
qtr4	-0.0734	0.1296 *	0.0337	0.0167	0.2167 *	0.0175	0.2006 ***	-0.0112
	(0.4945)	(0.0756)	(0.0391)	(0.0785)	(0.1211)	(0.0298)	(0.0191)	(0.033)
# of Cross Sections	18	19	35	66	1324	844	565	664
Time Series Length	12	12	22	24	12	12	22	24
R-Square	0.47	0.43	0.30	0.34	0.37	0.47	0.26	0.22

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 3B: Cross-sectional Time Series Regression with Random Effects
Sub-sample Periods – CRE Specialists and Commercial Loan Specialists with Real Assets <$50 Million

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively.

	CRE Specialists				Commerical Loan Specialists <=$50 mil.			
	1986-1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2	1986-1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2
Intercept	2.7126 ***	3.6065 ***	2.7963 ***	2.3004 ***	2.5168 ***	2.4953 ***	1.6914 ***	1.7292 ***
	(0.3436)	(0.2623)	(0.1412)	(0.0852)	(0.3113)	(0.2849)	(0.1928)	(0.2492)
Interest Rate Risk								
vol_1y1	0.3655	-0.7849 ***	0.3777 ***	-0.4768 ***	0.2044	-0.3966 ***	0.3127 ***	-0.4435 ***
	(0.2507)	(0.1557)	(0.0455)	(0.0386)	(0.1542)	(0.1246)	(0.0396)	(0.0754)
st_dummy1	-0.2399 ***	-0.1020	-0.0404	0.0451 **	-0.1881 ***	-0.1645 ***	-0.0309	0.0028
	(0.0792)	(0.0635)	(0.031)	(0.0189)	(0.0531)	(0.0563)	(0.0315)	(0.043)
stgap_rat2	0.0017	-0.0015 *	-0.0005	-0.0025 ***	-0.0005	-0.0016 **	-0.0008 *	-0.0028 ***
	(0.0014)	(0.0009)	(0.0006)	(0.0003)	(0.0008)	(0.0007)	(0.0005)	(0.0007)
nm_rat2	0.0139 ***	0.0110 ***	0.0079 ***	0.0049 ***	0.0120 ***	0.0087 ***	0.0073 ***	0.0056 ***
	(0.0017)	(0.0013)	(0.0007)	(0.0004)	(0.001)	(0.001)	(0.0006)	(0.0009)
stgap_sd1	0.0038 ***	0.0074 ***	0.0037 ***	0.0053 ***	0.0034 ***	0.0060 ***	0.0032 ***	0.0044 ***
	(0.0015)	(0.0009)	(0.0006)	(0.0003)	(0.0009)	(0.0007)	(0.0005)	(0.0007)
nm_sd1	0.0034 **	0.0071 ***	0.0040 ***	0.0054 ***	0.0032 ***	0.0087 ***	0.0030 ***	0.0054 ***
	(0.0014)	(0.0008)	(0.0006)	(0.0003)	(0.0009)	(0.0008)	(0.0006)	(0.0007)
Term Structure Risk								
ds5y_1y1	-0.7240 ***	-0.3140 ***	0.1606 ***	-0.0410 ***	-0.4897 ***	-0.1557 **	0.0428	-0.0828 ***
	(0.2544)	(0.0831)	(0.0319)	(0.0116)	(0.1545)	(0.0673)	(0.0267)	(0.0243)
ds5y_1y2	1.0705 ***	-0.0842	0.1092 ***	0.1568 ***	0.6729 ***	0.1873	0.1462 ***	0.1456 ***
	(0.3673)	(0.2225)	(0.0313)	(0.0134)	(0.229)	(0.1803)	(0.0267)	(0.0287)
ds5y_1y3	-0.5402 *	0.2372	-0.0183	0.0610 ***	-0.2639	0.1309	-0.0032	0.0807 ***
	(0.2852)	(0.1443)	(0.0248)	(0.012)	(0.1761)	(0.1158)	(0.0211)	(0.0268)
ds5y_1y4	-0.1533	-0.3639 ***	0.0383 *	-0.1226 ***	0.0036	-0.2109 ***	0.0340 *	-0.1298 ***
	(0.1156)	(0.061)	(0.0224)	(0.0143)	(0.0698)	(0.0483)	(0.019)	(0.0312)
Credit Risk								
dln_ast2	-0.0060 ***	0.0021	-0.0007	0.0005	0.0004	0.0001	0.0001	-0.0016
	(0.0021)	(0.0016)	(0.0011)	(0.0006)	(0.0014)	(0.0013)	(0.001)	(0.0014)
dci_rat2	0.0112 ***	-0.0122 ***	-0.0007	0.0008	0.0000	-0.0005	-0.0022	0.0061 **
	(0.0029)	(0.0023)	(0.0021)	(0.0012)	(0.0019)	(0.0018)	(0.0017)	(0.0025)
dcsprd1	-1.2700 ***	-0.0413	0.1449	0.1737 ***	-0.3179	-0.2093 ***	0.2640 ***	0.1263 **
	(0.4116)	(0.0968)	(0.1214)	(0.0275)	(0.2538)	(0.0782)	(0.1008)	(0.0551)
dnperf_rat2	-0.0161 **	-0.0105 **	0.0005	-0.0153 ***	-0.0091 **	-0.0028	0.0054	-0.0020
	(0.0074)	(0.0047)	(0.0037)	(0.0047)	(0.0043)	(0.0041)	(0.0047)	(0.0085)
Other Institutional Variables								
logast1	-0.1366 ***	-0.1720 ***	-0.1060 ***	-0.0838 ***	-0.0827 ***	-0.0812 ***	-0.0471 ***	-0.0579 **
	(0.027)	(0.0209)	(0.0115)	(0.0069)	(0.0289)	(0.0265)	(0.018)	(0.0239)
nim_rat2	-0.4357 ***	-0.4503 ***	-0.4274 ***	-0.3628 ***	-0.5094 ***	-0.4534 ***	-0.3517 ***	-0.3290 ***
	(0.017)	(0.012)	(0.0073)	(0.0049)	(0.0117)	(0.0111)	(0.0076)	(0.0091)
dnim_rat1	-0.6939 ***	-0.6076 ***	-0.6367 ***	-0.5580 ***	-0.7058 ***	-0.6822 ***	-0.5351 ***	-0.5084 ***
	(0.016)	(0.0112)	(0.0074)	(0.0052)	(0.01)	(0.0103)	(0.0084)	(0.0096)
dnonii_rat2	0.0165 **	0.0127 **	-0.0036	0.0024	0.0089 ***	-0.0011	-0.0105 **	-0.0085
	(0.0066)	(0.0064)	(0.0047)	(0.0035)	(0.003)	(0.0047)	(0.0044)	(0.0076)
dsecgl_rat2	-0.0081	-0.0131	-0.0480 ***	0.0243 *	0.0138	-0.0063	-0.0008	-0.0098
	(0.018)	(0.0182)	(0.012)	(0.0133)	(0.0096)	(0.0154)	(0.009)	(0.0246)
Seasonal Dummy								
qtr2	0.1216 ***	0.1846 ***	0.1467 ***	0.1285 ***	0.0753 ***	0.1736 ***	0.2012 ***	0.1598 ***
	(0.0405)	(0.0326)	(0.0162)	(0.0095)	(0.023)	(0.0262)	(0.0139)	(0.0188)
qtr3	0.7179 ***	0.1290	0.1886 ***	0.0297 **	0.4786 ***	0.1194 *	0.1958 ***	0.0759 ***
	(0.1391)	(0.0824)	(0.0145)	(0.0119)	(0.0863)	(0.0666)	(0.0124)	(0.0233)
qtr4	-0.1881	-0.0033	0.1943 ***	-0.0260 **	-0.0611	0.0768 ***	0.1592 ***	-0.0441 *
	(0.1911)	(0.0243)	(0.0141)	(0.0114)	(0.1176)	(0.0189)	(0.0122)	(0.023)
# of Cross Sections	536	784	1404	2438	1212	1045	1280	1055
Time Series Length	12	12	22	24	12	12	22	24
R-Square	0.35	0.33	0.32	0.28	0.36	0.37	0.27	0.22

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Table 3C: Cross-sectional Time Series Regression with Random Effects
Sub-sample Periods – Other Commercial Loan Specialists

Independent variables are presented by types of risk they represent – interest rate risk, term structure risk and credit risk as well as institutional variables and seasonal dummy. Appendix 2 contains descriptions of all independent variables included in this table. All institutional specific variables, other than the log of total real assets (LOGAST1) are divided by average earning assets between two quarters. All variables beginning with "d" – for example DNIM_RAT – represent quarterly changes. Suffixes "1" and "2" represent one-quarter (t-1) and two quarter (t-2) lags, respectively.

	Commercial Loan Specialists $50 - $300 mil.				Commercial Loan Specialists >$300 mil.			
	1986-1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2	1986-1988	1989-1991	1992-1997:Q2	1997:Q3 - 2003:Q2
Intercept	1.2278 ***	3.4868 ***	1.7566 ***	2.3241 ***	0.9702 ***	0.6949 ***	2.0593 ***	1.8136 ***
	(0.3128)	(0.3063)	(0.1522)	(0.18)	(0.2507)	(0.2211)	(0.215)	(0.2036)
Interest Rate Risk								
vol_1y1	0.0347	-0.4297 ***	0.2805 ***	-0.3513 ***	-0.1775	-0.5719 ***	0.0785	-0.2818 ***
	(0.0998)	(0.1002)	(0.0277)	(0.0443)	(0.1394)	(0.1092)	(0.0573)	(0.071)
st_dummy1	-0.1105 ***	-0.3232 ***	-0.0899 ***	0.0876 ***	-0.0539	-0.3083 ***	-0.0059	0.0529
	(0.0371)	(0.0488)	(0.0251)	(0.0291)	(0.0535)	(0.0551)	(0.056)	(0.05)
stgap_rat2	-0.0003	-0.0033 ***	-0.0015 ***	-0.0011 **	0.0020 **	-0.0029 ***	-0.0023 **	-0.0036 ***
	(0.0006)	(0.0007)	(0.0004)	(0.0005)	(0.001)	(0.0008)	(0.0009)	(0.0008)
nm_rat2	0.0120 ***	0.0089 ***	0.0049 ***	0.0050 ***	0.0061 ***	0.0009	0.0076 ***	0.0029 ***
	(0.0009)	(0.001)	(0.0005)	(0.0006)	(0.0013)	(0.0012)	(0.0011)	(0.0011)
stgap_sd1	0.0027 ***	0.0051 ***	0.0035 ***	0.0039 ***	0.0016	0.0044 ***	0.0031 ***	0.0053 ***
	(0.0007)	(0.0007)	(0.0004)	(0.0005)	(0.0011)	(0.0008)	(0.001)	(0.0007)
nm_sd1	0.0020 ***	0.0078 ***	0.0043 ***	0.0029 ***	0.0006	0.0064 ***	0.0021 **	0.0049 ***
	(0.0007)	(0.0008)	(0.0004)	(0.0005)	(0.001)	(0.0009)	(0.001)	(0.0008)
Term Structure Risk								
ds5y_1y1	-0.3574 ***	-0.1234 **	0.1219 ***	-0.0346 **	0.0655	-0.1123 *	0.0544	-0.0127
	(0.0968)	(0.0546)	(0.0189)	(0.0143)	(0.1396)	(0.06)	(0.039)	(0.0229)
ds5y_1y2	0.4038 ***	-0.4158 ***	0.1357 ***	0.1119 ***	-0.0404	-0.5589 ***	0.0370	0.1264 ***
	(0.147)	(0.144)	(0.0187)	(0.0169)	(0.2086)	(0.154)	(0.0388)	(0.027)
ds5y_1y3	0.0254	0.3865 ***	0.0364 **	0.1069 ***	0.2582	0.5416 ***	0.0382	0.0510 **
	(0.1155)	(0.0927)	(0.0149)	(0.0158)	(0.1605)	(0.1004)	(0.0308)	(0.0252)
ds5y_1y4	0.0355	0.0053	-0.0079	-0.1032 ***	0.1011	0.0248	0.0716 ***	-0.1773 ***
	(0.0434)	(0.0387)	(0.0133)	(0.0185)	(0.063)	(0.0429)	(0.0277)	(0.0296)
Credit Risk								
dln_ast2	0.0009	0.0017	-0.0009	0.0022 **	-0.0003	0.0027 *	0.0109 ***	-0.0027
	(0.0011)	(0.0014)	(0.001)	(0.0011)	(0.0017)	(0.0016)	(0.002)	(0.0018)
dci_rat2	-0.0012	-0.0013	0.0039 **	0.0015	-0.0083 ***	-0.0035	-0.0085 **	-0.0021
	(0.0016)	(0.002)	(0.0017)	(0.002)	(0.0031)	(0.0027)	(0.0041)	(0.0038)
dcsprd1	-0.0549	-0.0225	-0.0486	0.1232 ***	0.3038	0.1655 **	-0.2002	0.2220 ***
	(0.1632)	(0.0626)	(0.0721)	(0.0323)	(0.2311)	(0.0703)	(0.147)	(0.052)
dnperf_rat2	-0.0095 **	-0.0128 **	0.0161 ***	-0.0073	-0.0109	-0.0148 **	0.0008	-0.0361
	(0.004)	(0.0056)	(0.0052)	(0.0075)	(0.0078)	(0.0075)	(0.0126)	(0.0223)
Other Institutional Variables								
logast1	0.0069	-0.1286 ***	-0.0566 ***	-0.0887 ***	0.0051	0.0239 *	-0.0399 ***	-0.0372 ***
	(0.0259)	(0.0252)	(0.0124)	(0.0149)	(0.0161)	(0.0144)	(0.0141)	(0.0134)
nim_rat2	-0.4745 ***	-0.5476 ***	-0.3213 ***	-0.3670 ***	-0.3222 ***	-0.2477 ***	-0.4476 ***	-0.3947 ***
	(0.0098)	(0.0118)	(0.0068)	(0.0077)	(0.0156)	(0.015)	(0.0141)	(0.0123)
dnim_rat1	-0.5886 ***	-0.7135 ***	-0.5805 ***	-0.5686 ***	-0.4742 ***	-0.4814 ***	-0.6647 ***	-0.5258 ***
	(0.0092)	(0.0104)	(0.0074)	(0.0077)	(0.0188)	(0.0169)	(0.0136)	(0.0119)
dnonii_rat2	0.0065 **	0.0058	-0.0091 **	-0.0090	0.0115 *	0.0132 *	-0.0351 ***	-0.0209 **
	(0.0031)	(0.0088)	(0.0041)	(0.0062)	(0.0063)	(0.007)	(0.0102)	(0.0089)
dsecgl_rat2	-0.0030	-0.0089	-0.0120	0.0358 **	0.0153	-0.0126	-0.0041	-0.0223
	(0.0065)	(0.0124)	(0.0075)	(0.0156)	(0.0144)	(0.0181)	(0.0137)	(0.0169)
Seasonal Dummy								
qtr2	0.0992 ***	0.1054 ***	0.1308 ***	0.1357 ***	0.1399 ***	0.0311	0.0692 ***	0.0933 ***
	(0.0142)	(0.0208)	(0.0098)	(0.011)	(0.0202)	(0.0235)	(0.0206)	(0.0177)
qtr3	0.4248 ***	0.2993 ***	0.1379 ***	0.0815 ***	0.2216 ***	0.2836 ***	0.1246 ***	0.0429 *
	(0.0535)	(0.0531)	(0.0087)	(0.0137)	(0.0777)	(0.0579)	(0.0182)	(0.0221)
qtr4	0.1319 *	0.1036 ***	0.1328 ***	0.0006	0.2836 ***	0.0521 ***	0.0843 ***	0.0133
	(0.0774)	(0.0151)	(0.0085)	(0.0134)	(0.1073)	(0.0169)	(0.0178)	(0.0218)
# of Cross Sections	1193	1070	1375	1398	351	388	406	358
Time Series Length	12	12	22	24	12	12	22	24
R-Square	0.34	0.36	0.32	0.28	0.26	0.22	0.34	0.35

Note: Standard error in parenthesis (* Significant at the 10% level ** Significant at the 5% Level *** Significant at the 1% Level)

Chart 1: Median Quarterly Net Interest Income and Non-interest Income as a Percentage of Average Earning Assets (Annualized Percentage Points) – Cont'd
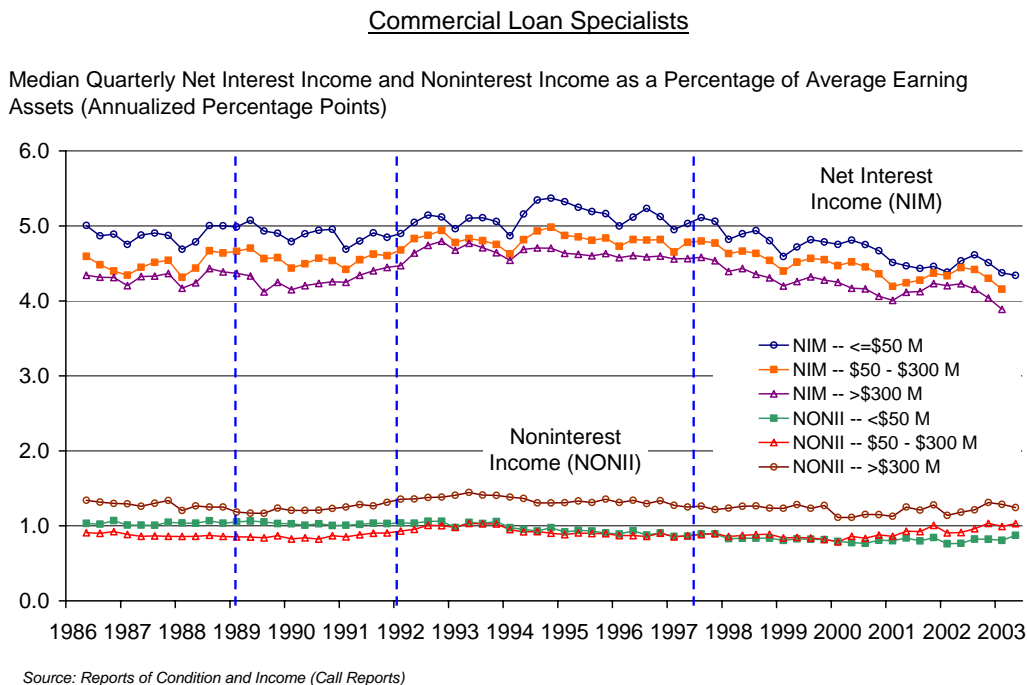
Commercial Loan Specialists

Median Quarterly Net Interest Income and Noninterest Income as a Percentage of Average Earning Assets (Annualized Percentage Points)

Source: Reports of Condition and Income (Call Reports)

Chart 2: Trends in the One-Year Treasury Yield and Its Volatility (1986:Q2 – 2003:Q2)

Quarterly Volatility of the One-Year Treasury Yield   Average One-Year Treasury Yield for the Quarter (%

Source: Haver Analytics and the Federal Reserve Board

Chart 3: Net Short-Term Assets as a Percentage of Earning Assets
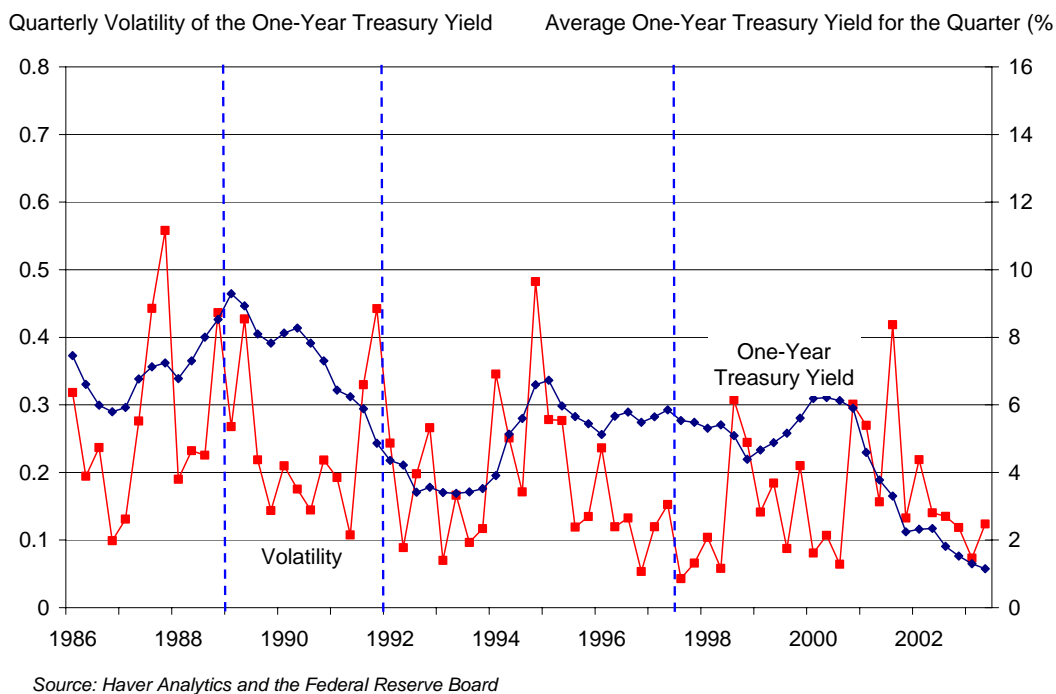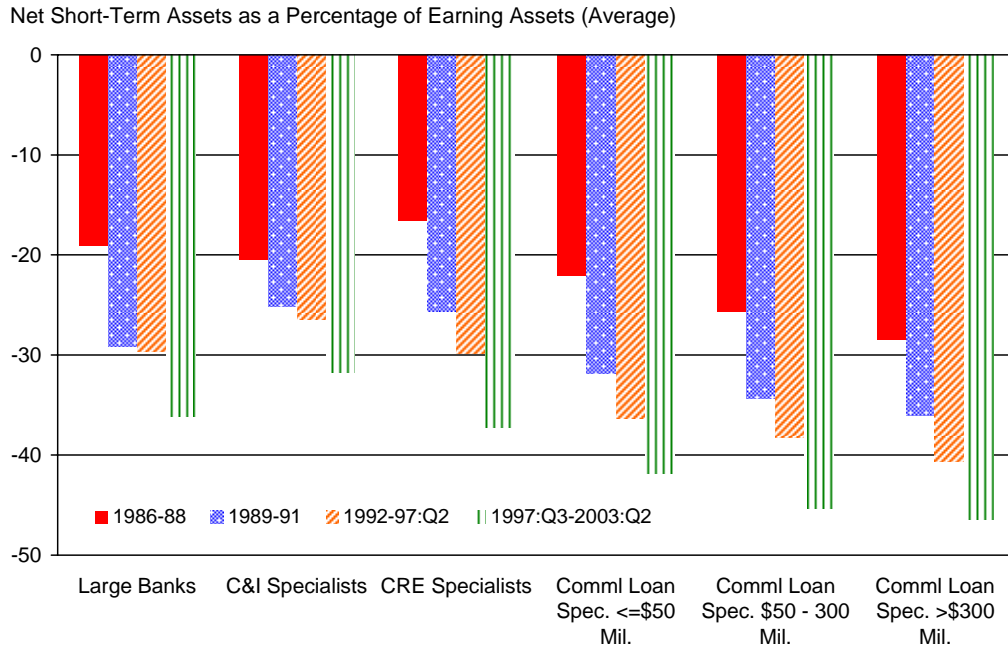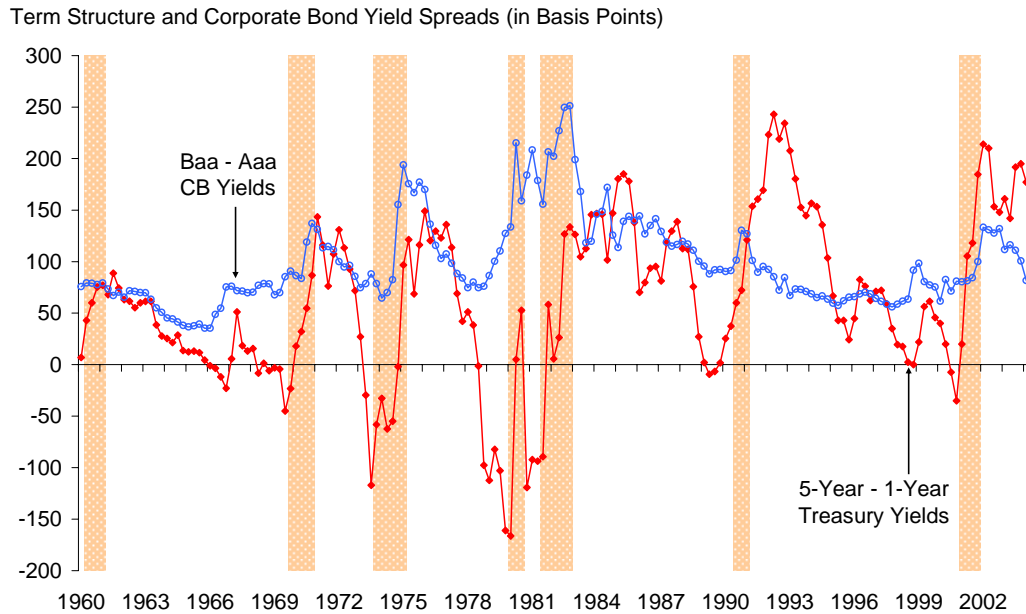
Net Short-Term Assets as a Percentage of Earning Assets (Average)

Source: Reports of Condition and Income (Call Reports)

Chart 4: Term Structure, Credit Spread and Business Cycle

Term Structure and Corporate Bond Yield Spreads (in Basis Points)
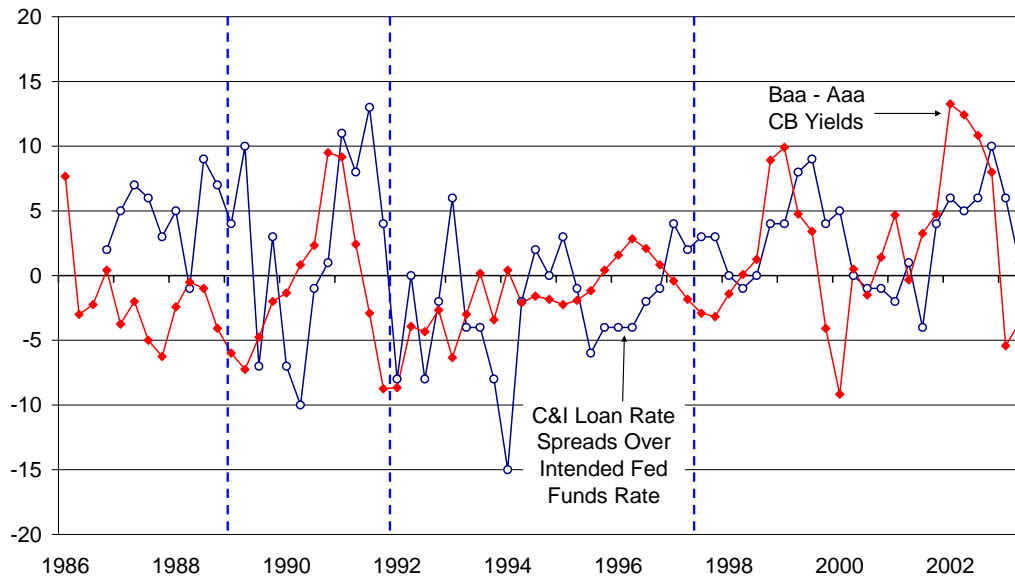

* Shaded areas represent recessionary periods as defined by the National Bureau of Economic Research (NBER).

Source: Haver Analytics and Federal Reserve Board

Chart 5: Commercial Bond Spread and C&I Loan Rate Spread: 1986 – 2003:Q2

Quarterly Changes in Yield Spreads Between Aaa and Baa Corporate Bonds and C&I Loan Rate
Spreads Over Intended Fed Funds Rate (4-Quarter Moving Average -- Basis Points)

Source: Haver Analytics and Federal Reserve Board